ELECTRICAL REVIEW

ILLUSTRATED.

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Electric Light, Power, Telephone, Telegraph and Scientific Progress.

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Ayres' Street Indicator.

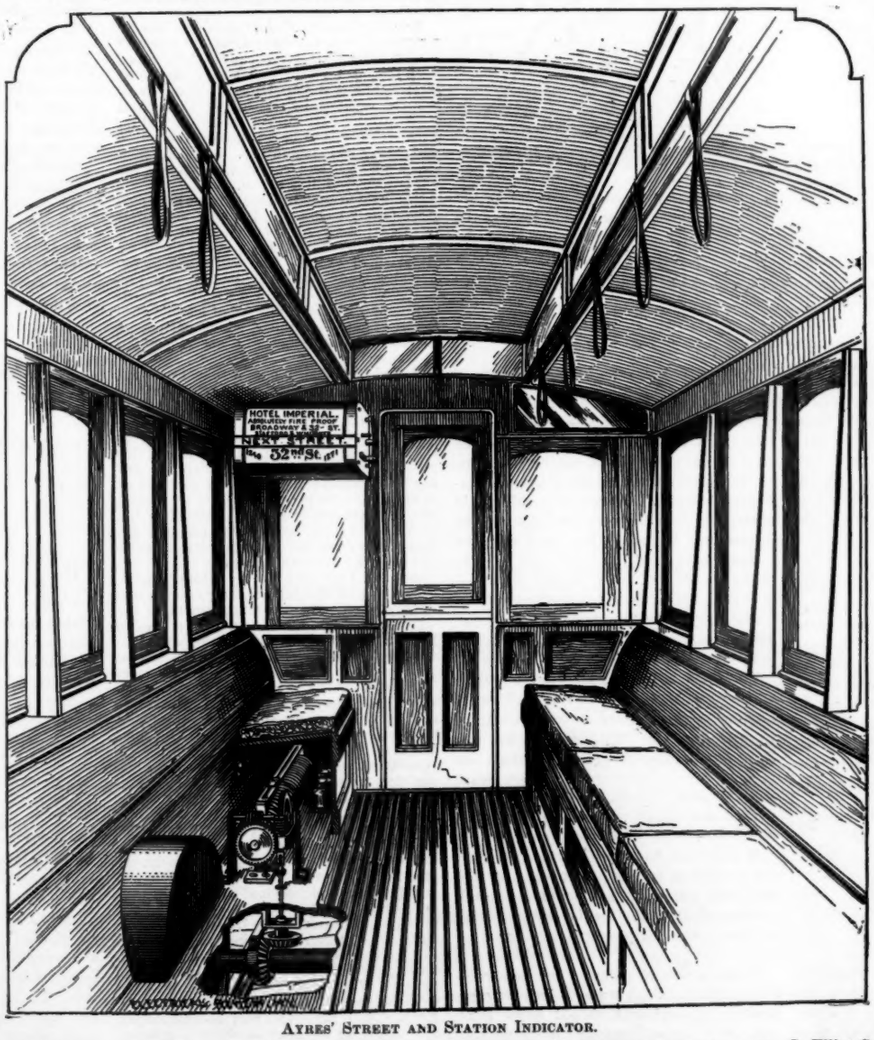
At the Hotel Imperial, Broadway and Thirty-second street, New York city, there is now on exhibition a new automatic device designed for use in street and steam railway cars to announce the names of streets and stations, the building numbers included in a city block and for advertising purposes.

Mr. R. B. Ayres, of this city, is the inventor of the device. It is understood that a stock company with ample capital will immediately be formed to exploit the invention. Negotiations for its introduction on a number of important street and steam railway lines are now in progress.

Our illustration on this page shows how the indicator and its controlling mechanism will look when placed in a street car. A bevel gearing transmits the motion of the car axle to an upright shaft, which is provided with a universal joint and open spring so adjusted as to allow free play and yet take up motion in all directions, caused by the vibrations or oscillations of the car body in passing over the rails. The motion of this shaft is imparted by proper gearing to a worm set longitudinally. The slot of the worm is provided with contact points corresponding in number to the streets or stations passed in the trip. The spaces between the contact points are scaled to the distances between streets or stations. A traveling contact fitting into the slot in the worm is carried along, as shown in the cut. Current may be furnished by dry or liquid batteries. All the mechanism thus far described is carried out of sight beneath the car seat.

The indicator proper consists of a handsome metal nickel-plated case enclosing two rollers actuated by a coiled spring and carrying the tape on which is painted the name of the street or station, the house numbers and the advertisement. The motion of the rollers is controlled by an electro-magnet connected with the worm and suitable gearing. The coiled spring requires to be wound once in a round trip. When the indicator is used on electric lines, a small electric motor will be employed to move the rollers. The tape runs between two metal strips, and when the proper length has been unwound a small hole in the tape allows a spring roller to come through and close the circuit, stopping the motion of the rollers. Should the motion of the car be reversed, a reversing lever on the indicator can be thrown, so that at all times the names on the tape are kept in correct relation to the streets or stations.

The size of the indicator depends on the number of streets or stations traversed in a round trip and the space to be occupied in the upper left hand corner of the car. The great advantages of having the name of the next street and the house numbers included in the next block before the eyes of passengers are obvious, and for this reason Ayres' indicator will, undoubtedly, be favorably considered by all progressive street railway officials. Steam railroad officials who have examined this device have pronounced it automatically and mechanically correct and just the thing they have been trying to find.



AYRES' STREET AND STATION INDICATOR.

A Pleasant Word from Illinois.

The following letter is one of many of similar tenor that cheer the REVIEW staff from time to time:

KEWANEE, ILL., February 28, 1891.

ELECTRICAL REVIEW, New York:

Please find enclosed New York draft and for same renew my subscription to the best electrical paper published—the ELECTRICAL REVIEW.

Yours truly,

(Signed) H. H. PERKINS.

Mr. Perkins is a gentleman of discernment and has our best bow for his kind words.

The Montreal Meeting of the Electric Light Association.

The following from the Montreal *Daily Star* indicates the interest that is already being taken in the next meeting of the Electric Light Association by our Canadian friends:

Mr. A. J. Corriveau has returned from the National Electric Light Association Convention, which was held at Providence, R. I. The American electricians, Mr. Corriveau says, look forward with great enthusiasm to the next Summer Convention, which will be held in Montreal some time in August next. It is the intention to make this Convention of unusual interest, and over 500 members will be present. The exhibition of electrical appliances and machinery will be one of the most interesting ever seen, and it is hoped that the Customs department will give every facility to the Association in bringing their exhibits here.

The January and February, 1891, issues of the *Western Engineer*, published by the Pond Engineering Company, St. Louis, have been received. It is an excellent publication.

New York City Sued for Big Damages.

On Monday of this week it was expected that the city of New York would file an answer to the suit for damages brought by the Brush Electric Illuminating Company and the United States Electric Illuminating Company, who are suing to recover damages caused by the city in the ruthless destruction of their poles and overhead circuits, beginning in December, 1889. The first named company places its damages at $525,000, while the latter presents a claim for $550,000, making a total of $1,075,000 which the city will be called upon to pay. These claims include the temporary loss of business caused by the destruction of the poles and wires. The city has already been granted a stay of 20 days, and it is possible that another stay may be asked for. The city will claim, in defence, that it has the right to regulate structures in the public thoroughfares which affect the life and health of the public, and that the plaintiffs had wrongfully neglected and refused to remove the poles.

The Submarine Cable of the Paris London Line.

The length of this cable will be 21 knots, its resistance at normal temperature (20° C.) 7,478 to 7,632 ohms; its capacity .3045 microfarad per knot. The cable consists of four copper cores, insulated from one another and having seven strands of wire each; the weight of each wire will be 20 kg. per knot. The weight of the Chatterton compound is 80 kg. per knot. The external covering consists of hemp, and the cable is armored with seven galvanized iron wires of 1¼ mm. diameter and of a tensile strength of 1,700 kg. The English portion of the line weighs 200 kg. per mile, the French, 400 kg. per mile. The latter being twice as long as the former—60 miles against 30—the conductivity of both sections is identical. —*London Electricity.*

Compliment to City Officials.

The Board of Fire Commissioners of New York recently adopted the following resolutions, which were well merited by the gentlemen named:

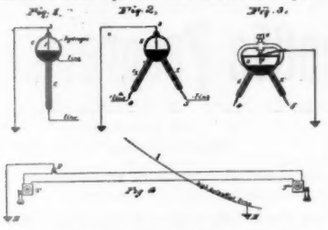
Resolved, That the Board of Fire Commissioners hereby directs the entry in the minutes of its high appreciation of the excellent judgment and tireless energy displayed by Chief of Department Hugh Bonner, and by Superintendent of Telegraph J. Elliot Smith, in promptly and successfully meeting the serious emergency which arose from the destructive storm of January 25, 1891.

Resolved, That the cheerful alacrity with which, during the same period, the members of the uniformed force, from the highest to the lowest, responded to the call of the Department for extra and unusual work, merits the greatest praise, and is but another proof of the high conception which they have very properly formed of the requirements of public duty.

PROGRESSIVE ELECTRICAL INVENTIONS.

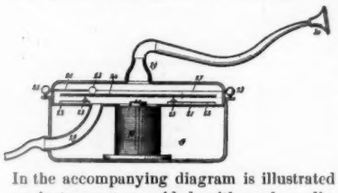
CUT-OUTS.

We illustrate herewith a new form of cut-out designed by Mr. Stephen D. Field. The invention is based upon the fact that hydrogen gas has a lower resistance than atmospheric air. A glass tube containing mercury is provided with line connections so as to form a part of the circuit to be protected. A ground terminal is mounted upon a bulb in the tube, with its tip in close relation to mercury, the space in the bulb not occupied by the mercury being filled with hydrogen gas. Under these circumstances an increase of potential in the circuit causes the resistance of the hydrogen gas to be overcome, and a spark passes through the hydrogen to the earth terminal. The increased flow of current causes volatization of the thread of mercury in the stem of the tube, which creates an opening in the column of mercury and ruptures the continuity of the circuit. When the potential of the line is restored to its normal condition, the mercury condenses and the apparatus resumes its initial condition. The diagrams show several forms of tubes, in all of which the same end is accomplished, Fig. 2 showing a tube provided with two stems, and Fig. 3 a similar tube provided with the terminal 3 mounted on a yielding diaphragm. Fig. 4 illustrates the application of the invention to an ordinary metallic circuit for telephone use, wherein the circuit is liable to be crossed by the conductor L carrying a high potential current and grounded at some point, as E. The potential cut-out is indicated at P, which fully protects the telephone and prevents liability of shock to the user. Other applications are contemplated for the invention, such as use in protecting the house circuit of an alternating current system, in which case the columns of mercury will be sufficiently heavy to carry the current without permanent injury. The valuable feature of the invention is the fact that the cut-out automatically restores itself for future protection after temporary irregularity of the line current ceases.



HARMONIC TELEPHONE.

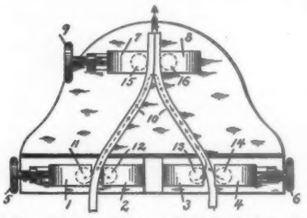
An ordinary telephone receiver, in which the edge of the diaphragm is circumferentially clamped, will respond to all rates of vibration, and, in fact, must do so in order to transmit speech. Mr. E. J. P. Mercadier, of Paris, has constructed a telephone in which the diaphragm is so mounted that it will respond to a single rate of vibration only, thus rendering the diaphragm analogous in its action to a tuning fork and fitting it for use in a system of multiple harmonic telegraphy.



In the accompanying diagram is illustrated an instrument provided with such a diaphragm. A partition 21, mounted in a box, which encloses a magnet 18, supports three guides 22, carrying adjustable studs 23, to support an iron diaphragm 24. The studs can be moved radially so as to shift the three points of support to different points of the disk. When a circular resonant disk is set into vibration by a tone which is the first harmonic of its fundamental tone, a circular nodal line will be formed on the disk, the radius of which nodal line is a trifle less than two-thirds of the radius of the disk. The supporting studs referred to are adjusted so as to respond to the nodal line of the first harmonic of the diaphragm, and said diaphragm will then respond to a rhythm due to the first harmonic and no other. Inasmuch as the nodal line cannot be determined with absolute accuracy and the studs cannot at first be perfectly adjusted, an adjusting weight 25 resting on the diaphragm and connected on one side with an elastic cord 26, and on the other side with a winding peg 28, is used to compensate by shifting the weight along the diaphragm until the diaphragm responds powerfully to the desired rate of vibration. Suitable sound-conveying tubes, as indicated, are provided, to convey the vibrations to the ear of the listener. As a receiver the vibrations are communicated to the diaphragm by the waves of magnetism induced in the core 20, and unless these are of a proper frequency the diaphragm will remain silent.

IMPROVEMENT IN WELDING.

In the accompanying diagram is illustrated a welding improvement invented by Messrs. Lemp & Schmidt, of Lynn, Mass. The design is to form a longitudinal metal joint between two long pieces of metal. As will be understood from the diagram, the pieces of metal 10 are fed between rollers to a pair of pressure rolls 15, 16, and the current is led through the two pieces of metal, as indicated by the arrows, passing through the high resistance point at the joint before the pressure rolls are reached. The parts of the metal are thus continuously heated by the current and softened sufficiently to form a weld before arrriving at the pressure rolls.



The Electro-Technical Exhibition at Frankfort.

REPORT BY CONSUL-GENERAL MASON.

In a report from this office to the Department which was published in Consular Reports No. 113 (February, 1890), some account was given of the nature and scope of the International Electro-Technical Exhibition, which it had been proposed to hold in this city from June to November of the present year, but which had been, for good reasons, postponed one year, and will be opened on May 15, 1891. We are, therefore, at present within less than seven months of the opening day of this important exposition, and preparations for it are already in active progress.

There being in Frankfort no buildings adapted to the requirements of such an exhibition, it was decided to construct them specially, and for this purpose a site was chosen on the tract of open land which was vacated by the railway companies, when they withdrew from their separate passenger stations and united in the great new union depot in 1888. The exhibition buildings will, therefore, be located between the chief railway station and the city, on ground supplied with water, gas and sewerage, as well as convenient tracks for the transportation of heavy machinery which may arrive by rail.

This necessity of planning and constructing special buildings made it also desirable that the management should know some time in advance the approximate number and character of the exhibits to be accommodated, and, accordingly, the entry lists were closed at the end of July last.

There are now on the books something more than two hundred exhibitors, representing principally, of course, Germany, but also in a large degree Great Britain, France, Belgium, Austria, Switzerland, Russia and the United States. In view of the important nature of this competition and the practical results which it may entail, it was to have been hoped that our country would have been more largely represented. The two American companies which have entered, however, rank among the foremost and most important in the United States, and, as they will be supplemented by an imposing display by the Edison Phonograph Company, of London, it may be hoped that the American exhibit will be, in character at least, worthy of the occasion. But there is a feeling of disappointment here that some of our electricians, who have done so much for the success of previous exhibitions on both sides of the Atlantic, are not to be represented.

The classification of exhibits has been slightly modified since the earliest announcements. They are limited to such as may be properly grouped under the following heads, viz.: (1) Apparatus for the production of electricity; (2) transmission, with all transmitting and supplementary appliances; (3) accumulating and transforming apparatus; (4) transmission of electric power for industrial purposes; (5) motors for electro-technical purposes; (6) electric lighting, with a special subdivision for fittings; (7) telegraphy and telephony; (8) electric signaling for railway, marine, mining and military purposes; (9) electro-metallurgy and electrolysis; (10) electrical instruments for measurement, acoustic and optical purposes; (11) electricity as applied to medicine and surgery; (12) the literature of electro-technology.

The entry list shows that in each of these departments the display will represent the latest and highest achievements of electrical science. There will be exhibited five different types of electric railways, and an electric yacht, or launch, adequate in size to carry 100 persons. There will be, also, five different systems of long-distance transmission for electric power, one of which, it is promised, will transmit 300 horse-power a distance of 50 miles.

Another feature of the exposition will be a series of 20 workshops adapted to different forms of mechanical work, and each equipped with the most recent and highly improved electrical tools and appliances. These shops will be manned by skillful workmen, and kept in operation during exhibition hours. Finally, there is to be an extensive scientific and industrial laboratory, supplied with every material and complete apparatus for experiment and illustration.

The exhibition will be, in scope and purpose, purely technical. It offers no medals or prizes; no award except the verdict which will be rendered concerning each exhibit by its board of experts, who will make an exhaustive study of the exhibition, and present their conclusions in a detailed report. This board will be composed of leading electricians from all countries which participate in the exhibition—men who are recognized as authorities in their profession; and it is expected that their report will constitute a practical text-book for electrical constructors, and a guide for municipalities, companies or individuals who are contemplating the application of electricity to any industrial or scientific purpose. It will be the aim of this report to consider fully and fairly all that has been achieved thus far to subordinate electricity to the practical uses of life, point out what yet remains to be invented or improved, and demonstrate what progress has been made since the last international exhibition of this kind was closed.

As was intimated in my former report, the results of the forthcoming competition are likely to be of important moment to the successful exhibitors. In all that relates to the use of electricity for lighting and as a motive power, western Germany is behind Italy and several other countries of Europe. The people are by nature and education conservative. They appreciate the advantages of electric railways and illuminators, but they have waited through the experimental stages of the science for the best and most economical system. There are many municipalities, manufacturers, and street railway companies that have in principle adopted electrical lighting systems and motors, and they are waiting for the verdict of this exhibition to decide which particular machine or method they shall employ. Finally, no effort will be spared to fully utilize the exposition as an educational opportunity. A letter has recently been addressed by the board of managers to the Minister of Public Instruction at Berlin, setting forth in detail the prospects of the enterprise, and the advantages that it will offer to students of technology. This will be communicated to schools and universities throughout the Empire, and Frankfort will become during the vacations of next summer a meeting ground for hundreds of teachers and students in the fascinating and important field of electrical science.

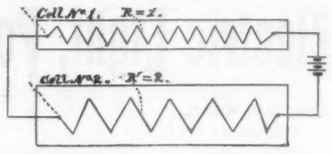
Westinghouse.

The time for subscribing to the new preferred stock of the Westinghouse Electric Company expired February 28. As the full amount of preferred to be issued (60,000 shares) has not been subscribed for, the time will probably again be extended. However, no action is known to have been taken by the directors on this matter.

Experimental Demonstration of Joule's Law.

An experimental proof that the heat of a current is directly proportional to the resistance and as the square of the current, is furnished by Prof. Robt. Spice, of Brooklyn. Professor Spice thus describes it:

The method employed is to send a current through a known resistance (spiral) immersed in a known quantity (volume) of kerosene (or any liquid), and also to immerse in the same liquid one set of junctions of a small thermo-battery, which is connected with a galvanometer fitted for projection on a screen. The other set of junctions are immersed in another vessel in a known volume of kerosene, in which is another known resistance (spiral).

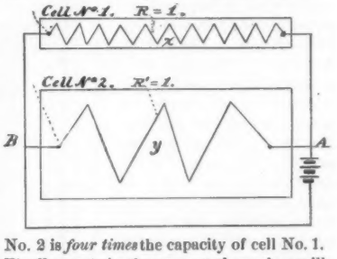


It follows from this arrangement that if both quantities of kerosene are *heated* (by the current) to the *same* temperature the galvanometer will remain at zero, but not otherwise.

Referring to the sketch (plan), it will be seen that the two resistances (R and R^1) are connected in *series* with the battery, and, therefore, the *same* current traverses both. R is a resistance=1. R^1=2. Cell No. 1 has capacity 1. Cell No. 2 has capacity 2. The heat developed in R^1 will be *twice* that developed in R. But R^1 is heating *twice* the quantity of liquid that R is, and so the result is that both liquids are raised through the same range of temperature. Q. E. D.

Referring to the lower sketch, it will be seen that the current divides at A, part going through x to B, the other part through y to B. The *total* resistance from A through x to B is represented by 2. The *total* resistance from A through y to B is represented by 1. Therefore, *twice* the current goes through y that goes through x.

Next, in the cells, the resistance of x is the same as y. But the capacity of cell No. 2 is *four times* the capacity of cell No. 1. Finally, as *twice* the current through x will give four times the heat, and as this happens in y and in the presence of four times the quantity of liquid, the temperature rises equally in each cell, as before, and thus the law is proved.



Unwelcome Magnetism.

In a recent lecture Professor Nichols was demonstrating the fact that an iron rod becomes a magnet by forcibly striking one end while holding the rod in a north and south direction. By way of illustrating his remarks he told how, while yachting several summers ago, he was sailing from the Isle of Shoals toward the coast of Maine, when it was noticed that a large mountain in Maine, a landmark, had unaccountably moved several points away from its natural position. Under the supposition that the compass was being affected in some way, everything around it was moved away, but to no purpose, the mountain refused to move, until, finally, an umbrella which was lying near by was removed, when the mountain quickly moved back to where it belonged. The umbrella, as the owner walked along, had evidently been tapped against the ground which eventually caused the steel stays holding the cover to become quite strongly magnetized. When placed near the compass a deflection of the compass of several points had taken place.

Electric Lighting at the Marlborough Hotel.

The Edison General Electric Company has recently installed a handsome isolated incandescent plant at the Marlborough Hotel, Broadway and Thirty-sixth street, New York city. In Fig. 1 is shown the engine and dynamo room and the switchboard. Two 11x12 Ideal engines of 70 horse-power each are used. These engines are painted white, picked out in gold, and make a very handsome appearance. The fly-wheels are covered with an oil-proof paper, which gives the belts a better biting surface and enables the bearings to run very cool.

The dynamos are Edison No. 16. These machines have been running day and night since February 1, without a moment's stop from any cause. Copper bars and rods are used on the switchboard, which was put up by Mr. McCabe. Connection is had with the street mains in case of a failure in the hotel plant. A handsomer or better kept dynamo room would be hard to find.

Some of the artistic fixtures are shown in Fig. 2, which represents one corner of the dining room. The fixtures are by Bergmann, and are advantageously placed for the distribution of light, besides being artistically prominent. The bull's-eyes in the ceiling and the suspended lights on the columns present a pleasing effect when glowing.

The hotel is wired for 2,000 lights.

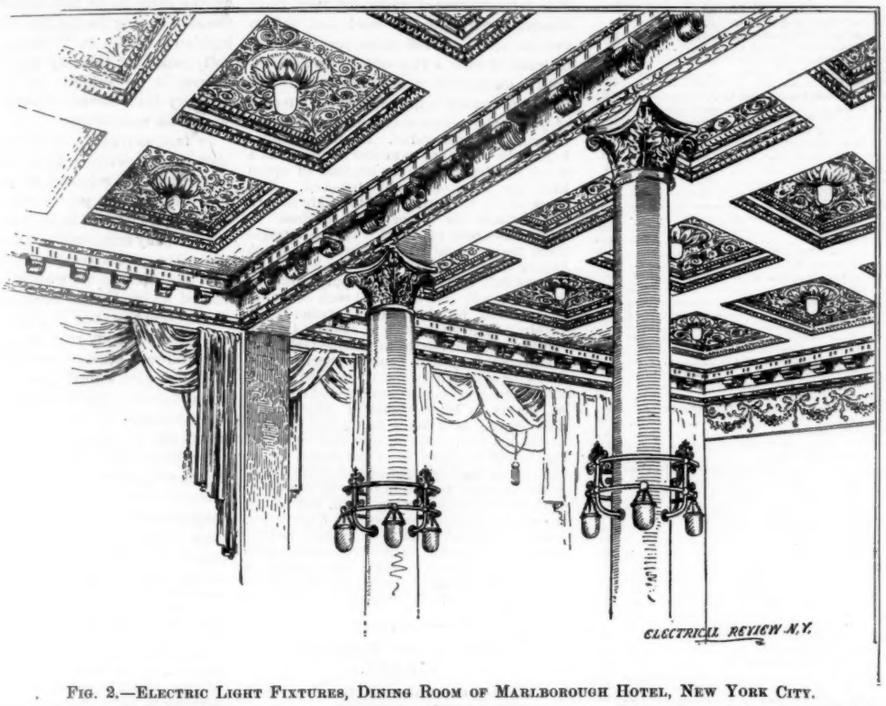


FIG. 2.—ELECTRIC LIGHT FIXTURES, DINING ROOM OF MARLBOROUGH HOTEL, NEW YORK CITY.

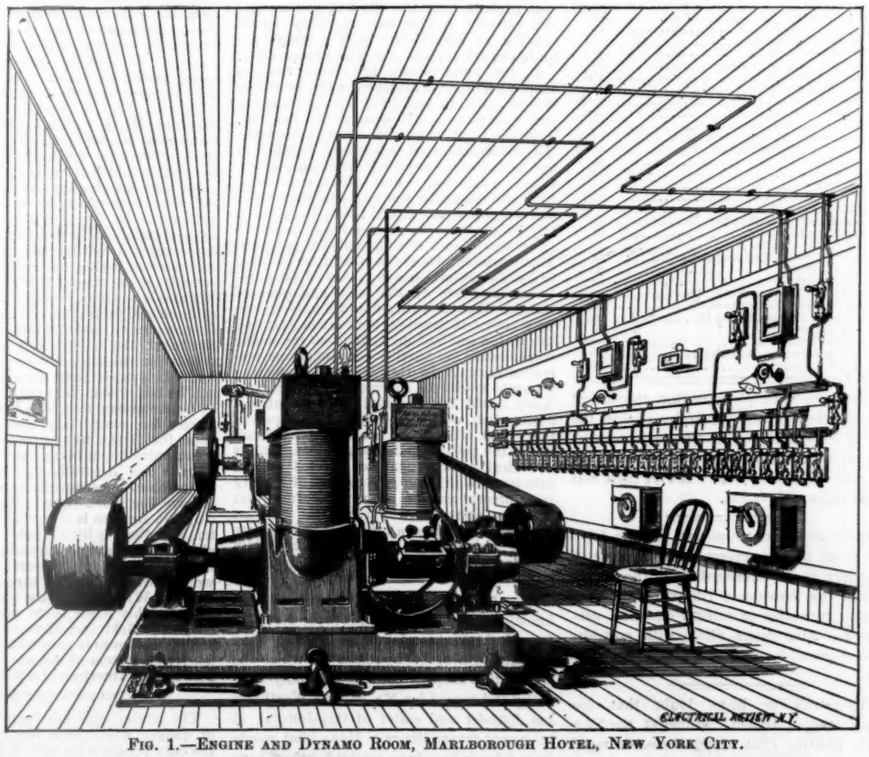


FIG. 1.—ENGINE AND DYNAMO ROOM, MARLBOROUGH HOTEL, NEW YORK CITY.

Franklin's Practicality.

In his new discovery Franklin immediately saw the means for producing something "of use to mankind," which, as he had written to Collinson in April, 1749, he was "chagrined a little" that he had hitherto been unable to do. His speedy invention of the lightning-rod gave to the world the only apparatus directly applicable to the service of man that has ever yet been devised for utilizing or controlling any of the forms of electricity known to Franklin and his contemporaries. In this haste of the philosopher to make his discovery serve a practical end, we recognize the man, Franklin—the man who exhibited in so many ways the characteristics of a later time—the nineteenth century American. Scientist and engineer, literary man and journalist, philosopher and man of affairs, Franklin was by nature what society and the growth of the great newspapers, and the stimulating rewards of the patent system, make so many of his successors. Franklin's discussions of the single fluid theory of electricity, and his whole writing upon the subject of his electrical labors, show that he possessed in a large degree the scientific mind. But he also had the inventive faculty and the will to exercise it. The natural union of these attributes is not so common as might seem to one of our generation. The modern way of life tempts every scientific teacher to turn his laboratory into a workshop, just as the allurements of journalism tempt the majority of the poets and historians away from their natural callings.—*George Herbert Stockbridge, in New England Magazine for March.*

Obituary.

Mr. John Hollins Bowley, once an assistant to Professor Morse, the electrician, and who superintended the laying of the first Atlantic cable from the American man-of-war Niagara, died on Sunday last at Jersey City. He superintended the erection of wires in the early days of telegraphy and assisted in devising plans for the electric subways.

Medina, N. Y.—Medina Electric Company; capital, $20,000.

Pueblo, Colo.—Citizens' Electric Company; capital, $100,000.

Newark, N. J.—The Eckert Electric Company; capital, $300,000.

Atlantic, Ia.—Harding Electric Railway Company; capital, $1,000,000.

Norristown, Pa.—The Norristown Traction Company; capital, $100,000.

Fulton, N. Y.—The Fulton Electric Light and Power Company; capital, $80,000.

Denver, Colo.—Continental Railway and Telegraph Company; capital, $200,000.

Charleston, Ill.—Charleston Thomson-Houston Electric Company; capital, $40,000.

Denver, Colo.—The Midland Electric Company, to deal in electric machinery; capital, $150,000.

Jersey City, N. J.—The Railway Electric and Auto-Pneumatic Signal Company; capital, $500,000.

Burlington, Kan.—The Electric Appliance Company; capital, $2,000. Directors: Warren Harrington, E. F. Morton and R. Wingren.

Athol, Mass.—Athol Gas & Electric Company; capital, $25,000. G. C. Moses, president; F. R. Davis, treasurer, and I. H. Bickford, secretary.

Des Moines, Ia.—Amended articles of incorporation increasing the capital stock of the Des Moines Electric Street Railway Company to $2,000,000 have been filed.

Lincoln, Ill.—Lincoln Electric Street Railway Company; capital $65,000; to build a street railway. Incorporators: E. D. Blinn, A. Quisenberry and John F. Mundy.

Mt. Sterling, Ill.—The Mount Sterling Light and Power Company; capital, $10,000. Incorporators, F. W. Rottger, A. Bailey, E. Schonen, H. Stark, W. Brockman, W. L. Carey and S. T. Ranney.

Chicago, Ill.—Continental Electric Construction Company; capital, $250,000. To build, equip and operate street railways, electric light, power and heating plant. Incorporators: William F. Orrell, Oren I. A. Heat, Leslie C. Orrell.

Brunswick, Me.—The Maine Electrical Improvement Company, to manufacture electrical appliances; capital, $9,900. The officers are: President, Alexander Henderson, Brunswick, Me.; treasurer, James L. Doolittle, Brunswick, Me.

Chicago, Ill.—Holson Electric Harness and Supply Company, to manufacture and deal in harness and electric devices and appliances for harness; capital, $250,000. Incorporators: Albert B. Holson, S. Whipple Gehr, Robert Lindblom and J. Joseph Wright.

Chicago, Ill.—Standard Electric Company; capital, $100,000; to manufacture electric light, motor and other machinery, cars and appliances, establish and operate electric light and power plants. Incorporators: William A. Conover, Francis E. Charnley, Frederick M. Clocke.

Telephone Companies' Officers.

A stockholders' meeting of the New York and New Jersey Telephone Company was held last week, at which the old board of directors was re-elected. The directors will meet this week and elect officers.

The New York and Pennsylvania Telephone and Telegraph Company has elected the following officers: Chas. F. Cutler, president; W. N. Estabrook, vice-president and general manager; H. F. Stevens, secretary; David B. Parker, treasurer. The board of directors is as follows: Chas. F. Cutler, W. N. Estabrook, David B. Parker, Henry L. Storke, John E. Hudson, Chas. A. Nichols, Horace C. French.

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No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

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We notice with pleasure that the suit of the electric lighting companies against the city of New York for the wholesale destruction of overhead circuits will probably be brought to an early issue. If ever there was a just claim, this is one.

Our esteemed contemporary, *Modern Light and Heat*, Boston, presented in its issue of February 28, a picture gallery of the attendants at the Providence Electric Light Convention and other prominent electrical gentlemen. Five pages filled with portraits were required for this interesting presentation.

There can be little doubt that the recent "rapid transit" dinner at the New York Electric Club brought electric rapid transit for this unhappy city one good step nearer to the front. The speeches were in every way worthy of the subject, and in the minds of all present there could have been but one opinion—that electric underground railways will form the solution of the difficulty which has so long oppressed us and caused the needless waste of our time and money.

ELECTRIC LOCOMOTIVES AT HIGH SPEEDS.

We publish in this number of the REVIEW Mr. O. T. Crosby's interesting paper on electric locomotion at high speeds. The experiments on a narrow gauge road at Laurel, Md., were conducted under the very grave disadvantages of a bad track and yet an average speed of 100 miles per hour was maintained over a two mile circular track with a locomotive weighing 2.4 tons. The figures presented in the paper being a record of practical experience and not mere speculation, are of great value. A curious feature is that the resistance to motion increases in a much smaller ratio to the increase of speed than has been ordinarily believed. The shape of the forward end of the train materially reduces the atmospheric resistance as might have been expected. With a straight track the speed might be raised to a much higher value than 120 miles per hour. Increased difficulty in current supply would be met, especially in a long line such as would be required for inter-urban traffic. Mr. Crosby's figures for such a system, though speculative, are interesting. One feature of his proposed system, namely, mechanically throwing a switch by the train itself to cut into circuit a normally disconnected conductor, seems to be of doubtful expediency. The impact of a train flying like a rocket at 220 feet per second on striking a switch at rest would create an enormous strain, and as the switch must be opened and again closed while the train passes, in order to leave it in position for the following train, liability of derangement might be expected. Experience, however, is always the best teacher, and the simplicity of such a mode of connection with the supply circuit, coupled with safety in using high potential currents, would, if found practically expedient, strongly commend its adoption.

THE NEW YORK SUBWAYS AT ALBANY.

Two measures affecting the New York subways are under discussion at Albany. One is in the shape of a bill to empower the Consolidated Telegraph and Electrical Subway Company to transfer all the conduits used for telegraph, telephone and low-tension wires generally, to the Empire City Subway Company, thus separating the control of the electric light subways from that of those used for signaling purposes. This transfer was proposed last year, but was prevented by the issuance of an injunction. It is more than probable that the bill will go through, and subway matters will probably benefit thereby, as the electric light subways are quite enough for one company to look after.

In the State Senate last week Senator Lispenard Stewart presented a bill by which it is proposed to authorize the construction and maintenance of subways by the city. The plan is of very wide scope, embracing the construction of sub-streets capable of accommodating anything from an electric wire to a railroad. The subways are to be built and owned by the city, and the cost of construction is to be paid for by the issue of city bonds, to be known as subway bonds, to the extent of not over $3,000,000 per year. There can be little doubt that if we are ever to have a comprehensive system of subways, to accommodate all the wires and pipes of the city, that the work should be undertaken by a body composed of the best engineering talent that can be found, and that the whole work should be carried out under one central authority. In this way all conflicting interests could be harmonized, and New York could be provided with a subway system that would be without an equal in the world. There are many grave difficulties in the path of such a scheme, and unless a radical reform can be effected in the manner in which the government of the city is at present carried on, we are afraid that the city subways which Senator Stewart proposes as a panacea for the evils that now afflict us must be considered a wildly Utopian dream.

The REVIEW feels that a word of acknowledgment is due from it to the National Electric Light Association, and no less to the friendly author, for the resolution which the Association adopted expressing kindly sympathy and regard for Mr. George Worthington, founder and editor of this Journal, in his recent severe illness. Many kind words from friends have been received, others have appeared in the columns of our contemporaries—always to be remembered by every one connected with this Journal and by Mr. Worthington, who is now regaining his health and strength, and enjoying, with his brother in Buffalo, his first vacation from zealous labor in the electrical field since he established the ELECTRICAL REVIEW a decade ago.

THE PACIFIC CABLE.

Our columns have several times of late contained reference to the various schemes on foot having as an object the establishment of telegraphic communication between this continent and Australia, by means of a submarine cable to be laid across the Pacific Ocean. During the last few weeks both the legislative bodies in Washington and the daily papers of this city have been taking interest in the subject, but to-day matters are very little further advanced than they were some months ago.

In fact, as regards one of the schemes, at least, a very severe setback has been experienced by the rejection of the bill which provided for the payment by the United States Treasury of a large annual subsidy to the company organized to lay and maintain the cable. This company was styled (we say *was*, because we presume that it is a case of no subsidy, no company) the Pacific Cable Company, but it proposed only, for the present at any rate, to lay a cable from the California coast to the Hawaiian Islands, a comparatively short link in the chain of communication that is required if a comprehensive system of Pacific cables is to be laid down, and it seems to us that if the thing is to be done at all it should be done well, and on the most liberal scale possible. Whoever starts out to lay cables in the Pacific should unquestionably do so fully prepared to occupy all posts of vantage, and so stand a fair chance of reaping the reward of his enterprise. The promoters of the Hawaiian cable petitioned Congress for a yearly subsidy of $250,000; in other words, a modest five per cent. on a capital of $5,000,000, in order to provide a cable some 2,000 miles long. It is evident that there was nothing small about the ideas of the gentlemen concerned in the scheme, and it is also apparent that their experience in cable matters is not very great. The subsidy was a little too generous even for the late very liberal Congress, and was reduced 40 per cent. in conference. Even in this amended shape, however, the opposition to the subsidy was too strong for the friends of the measure, and the bill was killed when it came up for final action.

The non-fruition of this particular Pacific cable scheme is not greatly to be regretted, however, as another American company is ready to lay a more extensive system of cables, extending clear from California to Shanghai, a distance of 6,500 miles, and this company asks no subsidy from the United States government, but merely the revival of an old charter which was granted by Congress in 1876 but lapsed in 1879, no cable having been laid. The old company was formed by Celso Cæsar Moreno, and with him were interested Senator Leland Stanford, Mr. J. C. Hood and several other California millionaires. The scheme fell through because the capitalists cooled off, not seeing sufficient return for their investment, and the charter was allowed to lapse. Mr. Moreno is now again to the front and is jubilant at the defeat of the Hawaiian subsidy scheme. He declares that his company is reorganized and is ready to go ahead with the work of laying the cables without any subsidy, if the charter is revived.

There is a strong feeling that the Pacific cable should be laid and owned by an American company, and for our part we should like to see the cable made in America, but submarine cables do not seem much in our line. It is moderately certain that the cable will be laid within the next few years, if not by an American, then by a British company. Such a line would have a strategic importance for Great Britain as affording direct communication between the mother country, Canada and Australia, and for a long time the colonial governments have been anxious to have the work done. The great "cable ring" in London is also stirring in the matter, and there is little doubt that if reasonable assistance be forthcoming in the shape of subsidies, that powerful combination would carry the project through and lay the cables. Whoever gets the start will be able to so lay his plans as to pretty effectually cover the field and shut out competition, and it remains to be seen whether the greatest telegraph system of the age is to be established as an American or a British enterprise.

The trolley wire has been found a source of danger wherever it has been tried, and the only people who want it in Philadelphia are those who think they see in it a source of pecuniary profit to themselves.—*Philadelphia Item.*

If the *Item* will print facts and figures showing that cars operated on the overhead electric system are as dangerous to human life as horse cars, maybe some unsuspecting Quaker can be made to believe its assertions.

CORRESPONDENCE.

OUR CHICAGO LETTER.

Mr. Theo. P. Bailey is at present in Boston investigating the improvements in the Thomson-Houston Company's railway system.

Col. P. F. Barr, ex-vice-president of the St. Paul City Railway, passed through the city *en route* to Streator, Ill., where he is now operating a street railway.

Mr. F. W. Cushing, of the Central Electric Company, is taking a much needed rest, and with Mrs. Cushing is at present sojourning at the Ponce de Leon, St. Augustine, Florida.

Chandler & Littlefield have secured the agency of the Triumph Compound Engine, of Cincinnati, Ohio. They are also agents for the Foote intermediate speed regulator.

The Belding Motor and Manufacturing Company have reconstructed their factory which was burned a short time ago, and commenced Monday to move into what is practically a new factory.

At a Meeting of the Chicago Electric Club, held on Monday evening, March 2, it was unanimously decided to at once discontinue the catering services which have been furnished by Kinsley.

The Illinois Electric Material Company are receiving requests for their new illustrated catalogue. It is one of the neatest we have seen, and should be in the hands of all in need of electrical apparatus.

Mr. George Cutter, among other good things, has received the agency for Spinney, Virtue & Company, of Lynn, Mass., manufacturers of rubber handles for pliers and rubber insulated screw drivers and socket covers.

Mr. Geo. B. Foster, formerly connected with the Chicago office of the Thomson-Houston Electric Company, has identified himself with the Illinois Electric Material Company in the capacity of general salesman. George is a good fellow and all wish him success.

Mr. F. B. Badt has been confined to his home for some days, but I am glad to say is fast convalescing and will be around in a few days. Professor Badt is at present manager of the mining department of the Western office of the Thomson-Houston Electric Company.

The Sunbeam Incandescent Lamp Company report business excellent. This firm have been compelled to increase their plant. They are putting in a 200 horse-power Atlas engine and two large incandescent dynamos. When completed the increase will give them a capacity of 3,500 lamps daily.

The Hill Clutch Works, of Cleveland, have recently closed some large deals for power transmission machinery in the West and Northwest. One of the large city plants for which they furnished the machinery was started a few days ago without a hitch and has been running along nicely ever since.

Mr. Wm. Hood, Western representative of the Accumulator Company, has just had fitted up and is placing on the market some very handsome portable accumulator outfits for physicians and private use. The boxes are nicely finished, and are made to receive all sizes and types of the cells manufactured by this Company.

Mr. Paul Bossart, of the Detroit Electrical Works, was in the city a few days last week. Mr. Bossart has just closed a contract with the West Side Electric Railway Company, of Kansas City, Kan., for an entire equipment of the Rae system. The plant includes six 80 horse-power motors and one 100 horse-power generator.

Mr. Dwight B. Dean, who for a long time represented the interests of the REVIEW in the West, and who recently became connected with the Electric Merchandise Company, of Chicago, as general sales agent, is at present absent on his maiden trip for this company. Dwight has a host of friends, and there is no doubt of his success.

Mr. C. M. Davis, of Pueblo, Colo., who is interested in the construction of electric roads in the West, was in the city a few days recently. He will shortly, in connection with Mr. P. Bossart, begin the construction of two electric roads in a prominent Western city. He has been investigating the advantages of some of the different systems.

The News of the Death of Mr. T. P. Conant was received in Chicago with deepest regret by his many friends and acquaintances. Mr. Conant had many friends in Chicago and Detroit. Mr. Wm. Hood, of the Western office of the Accumulator Company, who was associated with Mr. Conant in the interests of the above company, feels the loss of his friend very much.

The Mosher Arc Lamp Company are beginning to receive numerous orders for their arc lamp for incandescent circuits, and every mail brings lots of inquiries regarding the new lamp. The firm are receiving many congratulatory letters from those who have their lamps in use already. They have also perfected a new type of long-life carbon which has an actual life of 15 hours.

Mr. Alex. Kempt, special agent of the Brush Electric Company at Chicago, has appointed Mr. H. E. Baldwin general salesman for the Northwest. Mr. Baldwin is from Wellsville, N. Y., a graduate of Williams College, and has for some time been a diligent student of the different systems for lighting and railway service. Mr. Baldwin has many friends, and when meeting any of the boys on the road it will be a case of "When Greek meets Greek," etc.

Mr. F. W. Horne, of the Chicago office of the Thomson-Houston Company, recently closed a contract for the increase in equipment of the Salt Lake Rapid Transit Company. This company has heretofore used the Westinghouse and Sprague systems. He also sold the increase to the Rockford Street Railway Company, consisting of one 80 horse-power generator, three 15 horse-power motor trucks complete, of the Thomson-Houston Company's S. R. G. style.

Chicago, March 7. L. W. C.

OUR ALBANY LETTER.

A Gang of Linemen from Binghamton have been in Elmira stringing long-distance telephone wires on the route from Elmira to Ithaca.

The Utica Belt Line Street Railway Company is now to be managed by the Thomson-Houston Electric Company, which assumes $70,000 of the floating debt.

The Common Council of Albany on Monday night granted street railway privileges to the electric railways, allowing them to introduce railway lines on certain streets which now have none.

The Trial Trip was made with an electric car over the University and Lyell avenues line at Rochester, N. Y., March 2. All went in a very satisfactory manner. The large engine in the power house which has been delayed is now completed. There is now a total of 33 electric cars running regularly in the city. It is expected that the East Main street route will soon be opened up and also the North St. Paul street line. Nearly all of the company's cars are now in the city.

A Meeting of the stockholders of the Hudson River Telephone Company was held Thursday at noon at the office of General Manager and Secretary A. B. Uline. The following directors were elected: Joseph P. Davis, New York; John E. Hudson, Boston; C. J. French, Boston; D. B. Parker, New York; J. Bigler, Newburgh; H. L. Storke, Auburn; A. B. Uline, Albany. Owing to the absence of Messrs. Davis and Bigler, on account of sickness, the board did not elect officers or meet for business. Another meeting will be held next Thursday, when officers will be elected and action taken for putting the wires underground.

Mr. M. E. Graves announces that the electric light station at Oswego, N. Y., is complete. It is a fine electric light plant, and the public is invited to examine it and receive an explanation of the workings of the system. The new and handsome office of the company is also furnished. Papers have been filed in the county clerk's office at Oswego for the organization of the Fulton Electric Light and Power Company, with a capital of $80,000. G. M. Case, F. A. Emerick, L. C. Seymour, F. Delt and G. G. Chauncey, are the directors. It is the purpose of the company to acquire the present Citizens' Company, and also to buy the water power which they now rent.

Since the Syracuse Company has given up its contract to furnish electric lights in Watkins, N. Y., other companies have been looking up the matter. The Steuben Electric Company has had an agent in town. Mr. Bradley, the agent, proposes that a local company be formed, with $10,000 capital, to build a plant and run it, having full charge, and that this company shall give the Hornellsville Company a mortgage on the plant payable in ten years, as his people would furnish the money to build the plant and merely be secured in that they shall receive six per cent. a year on the capital, while the local companies would have all the profits of the plant, which electricians claim will pay over 20 per cent. The village is indignant at having been kept without lights for a number of months. The Hornellsville Company has a capital of $2,000,000.

Thomas A. Edison passed through Dunkirk, N. Y., some time ago in company with his wife. When questioned regarding the future of electricity, he said: "The time for holding back or resting contented with the advantages of the present went by with the introduction of the steam engine and electrical forces. It would be hard to prophesy what the future of electricity will be; and what new wonders it will accomplish. We can only judge in a limited way by what it has already done. The science of electricity might be said to be only in embryo at present. New discoveries and new knowledge of its wonderful power are developed every day. One day we do a thing and the next we undo it. Electricity will, no doubt, be an unlimited blessing in the future. It is one of the greatest, if not altogether so, natural forces known. Its wonders or possibilities cannot be estimated by the mind of man to-day." L. M. W.

Albany, March 7, 1891.

OUR BOSTON LETTER.

Mr. Chas. S. Pease, general manager Brush Electric Company, is making a short visit among friends in this city.

Mr. H. W. Goode, general manager North Western department of the Thomson-Houston Electric Company, is in town.

Mr. H. E. W. Palmer, general manager of the Atlanta, Ga., Thomson-Houston Electric Company, is on a business visit to this city.

Mr. J. R. McKee has just entered upon his new duties and responsibilities as general manager Thomson-Houston mining department.

The Worcester & Spencer Electric Railway Company has paid the requisite 10 per cent. of the capital stock, and is awaiting the arrival of its charter. As soon as it arrives, seven days' notice will be given, after which contracts for poles, ties and cobble paving will be awarded.

The Eastern Electrical Supply and Construction Company, of this city, has promoted Mr. Henry R. Kellogg to the management of its light and power department. Mr. Ferdinand E. Alexander, formerly of the Westinghouse Electric Company, will look after the electric light installations, central station and isolated plant work made by the above named company.

The Holtzer-Cabot Electric Company, of this city, now own and control the business of the Providence Construction Company, and the latter will, however, continue operations under its old name as the Rhode Island agency for the former. Mr. E. W. Fyler will retain, as previously, the management of the Providence agency but will make his headquarters at the Boston office.

The National Electric Tramway and Lighting Company, Victoria, British Columbia, operates the electric railway in that city and the town of Esquimault, and also the electric line successfully running between the city and town named. The company is making extensive additions to its station and increasing the number of cars. The recent increase to the power plant by a 300 horse-power Corliss engine will enable the company to extend its municipal and commercial electric lighting service. The Thomson Houston systems are used. W. I. B.

Boston, Mass., March 7.

Mr. Spaulding Corrects a Wrong Impression.

TO THE EDITOR OF ELECTRICAL REVIEW:

If you can spare the requisite space in your next issue, I should like to take advantage of your valuable columns to correct an impression which has caused the writer some embarrassment and annoyance during the past few weeks. I would respectfully inform those interested that the Henry C. Spaulding who is advocating an underground railroad for Boston, at an expense of something over $1,000,000 per mile, is an entirely distinct and different person from the undersigned, who is, at present, as during the past three years, connected with the Thomson-Houston Electric Company, and fully occupied with the direct work in hand without taking up the above subject. Yours respectfully,

H. C. SPAULDING, Secretary
Thomson-Van Depoele Elec. Mining Co.
Boston, March 7.

The Next Meeting of the American Street Railway Association.

The list of the committees to report at the tenth annual meeting of this Association, to be held in the city of Pittsburgh, Pa., the third Wednesday in October (the 21st), 1891, is completed and is as follows:

A Perfect Electric Motor.—H. A. Everett, secretary East Cleveland Railroad Company, Cleveland, Ohio.

A Year's Progress of Cable Motive Power.—J. C. Robinson, formerly vice-president Los Angeles Cable Railway Company, Los Angeles, Cal.

Public and State Treatment of Corporations, No. 3.—G. Hilton Scribner, president Central Park, North and East River Railroad Company, New York City.

The Dependent Overhead or Underground System of Electric Motive Power.—George W. Mansfield, director Attleboro, North Attleboro and Wrentham Street Railway Company, Attleboro, Mass

The Independent Storage or Primary Battery System of Electric Motive Power.—Knight Neftel, electrician Lancaster City Railway Company, Lancaster, Pa.

A series of robberies of the wires of the New York and New Jersey Telephone Company took place in Union county last week. A gang of daring thieves were operating, who climbed the poles, cut the wires and carried the latter off.

PERSONAL.

Mr. T. W. Sprague, of the Thomson-Van Depoele Electric Company, spent a day with New York friends last week.

Henry Schearer, the city electrician of Peoria, Ill., has been sentenced to three years' imprisonment for "burglarizing a saloon opposite the city hall and stealing $800."

Mr. J. E. Talbot, the talented missionary and artist connected with the Fort Wayne Electric Company, shone on his New York friends a few hours last week, and then hied away to Philadelphia to rest.

W. C. McDonald has given $40,000 to McGill University for a chair of electrical engineers. Some very handsome subscription have also been received to provide lectures for the chair of mining engineers.

Hon. James English, of New Haven, is paying a friendly visit to New York friends, and rejoicing in the prosperity of the many electric light stations through New England managed by his intelligent and wide-awake self.

Mr. John W. Ebert, one of the able young men connected with the business staff of the Western Electric Company, Chicago, was married February 26 to Miss Edith Price, of Denver, Colo. The REVIEW extends best wishes.

Mr. F. S. Terry, manager of the Electrical Supply Company, Chicago, is enjoying a visit in the East. One of the able young men of the electrical industry, Mr. Terry has won an enviable business success throughout the West, and is at the head of one of the leading electrical houses of the country.

Mr. D. B. Dean, who has long been our esteemed and industrious Chicago representative, has accepted a position with the Electric Merchandise Company, of that city. Mr. Dean has our best wishes, and we have no doubt he will win success. Mr. L. W. Collins will hereafter represent the REVIEW in Chicago, and we bespeak for him full courtesies from our Western friends.

Mr. W. A. Jackson, president of the Detroit Electrical Works, and one of the most prominent telephone men of the West, was a New York visitor last week, and paid the REVIEW a welcome visit. In addition to his already large electrical interests, Mr. Jackson has recently become largely identified with electrical railway work, where his energy and progressive ideas will be of great value.

President S. E. Barton, of the Electric Mutual Insurance Company, Boston, is reported by telegraph to be under arrest at Augusta, Ga., charged with violating the laws of that State, which require a deposit of $25,000 and a license for all insurance companies. Mr. Barton who, with Mr. L. Stieringer, was on a hunting expedition at the time, takes the matter good-naturedly, and states he is not aware that any law has been violated. It is supposed that rival insurance interests are at the bottom of the suit.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, March 7, 1891. New York, Boston and Washington Stock Exchanges. Pittsburgh closing March 6.

NEW YORK.	
Western Union Telegraph Co	80
American Telegraph & Cable	79¾
Central and South American	145
Mexican	210
Commercial Cable Co	106
Postal Telegraph Cable	39
Edison General Electric Co	100
" " Deferred	
Consolidated Electric Light	
Edison Electric Illuminating Co	79
United States Electric Light	30
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co	43⅝
" " " Preferred	25¼
" " " Series C	12¾
" " " Series D	6¾
" " International Co	
" Welding Co	
" European Welding Co	55
Ft. Wayne Electric Co	125⅝
TELEPHONE:	
American Bell	193¼
Erie	47½
New England	50
Mexican	.80
Tropical American	
MISCELLANEOUS:	
Edison Phonograph Doll	
WASHINGTON.	
Pennsylvania Telephone	25
Chesapeake and Potomac	55
American Graphophone	7
United States Electric Light (Wash'ton)	160
Eckington and Soldiers' Home Electric Railway	55
Georgetown and Tennallytown	60
PITTSBURGH.	
Westinghouse Electric Mfg. Co	

⁂ "Patience" should be taken off a monument and put at the end of a telephone.—*Washington Post.*

⁂ Inventor Keely is said to be working on a new telephone which is expected to revolutionize the system—perhaps.

⁂ Ground has been purchased by the New York and New Jersey Telephone Company, at 158 and 160 Market street, Newark, N. J., for a new telephone building that is to cost $150,000.

⁂ At the annual meeting of stockholders of the Newark, N. J., District Telegraph Company, held last week, the following were elected directors for the ensuing year: George W. Hubbell, Marcus L. Ward, Thomas T. Kinney, Edward Weston, Enos Runyon, Frederick T. Feary.

The Telephone Patents.

Respecting the question of the early expiration of the Bell and Blake patents in the United States, the Blake patents, Nos. 250,126, 250,127, 250,128 and 250,129, dated November 29, 1881, in the United States, were taken out in Great Britain on January 20, 1879, and it is stated will, consequently, expire January 20, 1893, in Great Britain, and on the same day will also lapse in the United States. The Bell patent of March 7, 1876, No. 174,165, will also expire in the United States on March 7, 1893.

Telephone Matters in Des Moines.

The city council recently came to the conclusion that Des Moines, Ia., was paying too much for telephone service. They did not send at once to the manager and demand lower rates, but waited until the company asked a favor. The telephone people finally requested permission to extend their lines through streets hitherto free from poles and wires. The council met and passed an ordinance permitting the company to do as it wished, provided that it would promise to put its wires underground whenever requested to do so, and would allow the city the use of 20 instruments gratis. General Manager Beach said he could never consent to this. Then the council amended its ordinance to provide that the telephone company pay three per cent. of its gross earnings for the use of the streets. Mr. Beach said that this was even worse than the other proposition, and proceeded to string his wires along the back fences of citizens who did not object. The councilmen threaten to have these wires cut, and the courts have been called in.

Troubled by Telephone Bells.

Telephone bells have been worrying unfortunate Mrs. Mary M. Winsgate, who appeared before Judge David D. Sherwood last week in the insane court, says the Chicago *Herald*. She was well dressed and refined and her voice was low. Her eyes twitched nervously, however, and the light in them was not natural. "I haven't a lawyer here," she said to the judge, "and there isn't any case against me, so I guess I'll be going." She started and it took two bailiffs to bring her back. After she had grown calm she consented to talk with the judge, and the jury listened intently. "I must find Edison today," she said; "he's the telephone man, isn't he? He has stuck telephones all over my house and one on the gate, and they keep ringing all the time, day and night, so nobody can rest or sleep. Sometimes I think it is the door-bell, and when I go to the door there is a little red-headed woman who slaps my face and runs away without saying anything. There is a black flag on my house right now. What is it there for? I pay taxes and nobody has the right to put a black flag on my house. We're all metalized—everything's metal in my house. I'm metal and so is my son, and there's a battery in the basement which has charged every one of us. Somebody puts drugs under my door to make me sick. Can't that be stopped? I've written to W. A. Pinkerton about it. He'll be here pretty soon and show you the letters." The judge asked her what she thought ought to be done. Mrs. Winsgate folded her hands. "I don't think anything," she said. "I pay taxes and the State must think for me." Dr. A. W. Gray testified that Mrs. Winsgate was dangerously insane, and she was taken to Kankakee.

The First Telephone Directory.

We are indebted to Mr. Morris F. Tyler, of New Haven, Conn., for the first list of telephone subscribers, or directory, ever published. Mr. Tyler is in possession of several of the "original Jacobs" of the telephone business and has sent us a photographic copy of the first page of the first telephone exchange order book ever kept, the original of which is in the possession of Mr. Geo. W. Coy, of Milford, Conn.

The only known original of the printed list is to be found in the office of the Southern New England Telephone Company, at New Haven, of which company Mr. Tyler is president.

We publish herewith the list, following style of the original:

LIST OF SUBSCRIBERS.

New Haven District Telephone Company,

OFFICE 219 CHAPEL STREET.

February 21, 1878.

Residences.

Rev. JOHN E. TODD.
J. B. CARRINGTON.
H. B. BIGELOW.
C. W. SCRANTON.
GEORGE W. COY.
G. L. FERRIS.
H. P. FROST.
M. F. TYLER.
I. H. BROMLEY.
GEO. E. THOMPSON.
WALTER LEWIS.

Physicians.

DR. E. L. R. THOMPSON.
DR. A. E. WINCHELL.
DR. C. S. THOMSON, Fair Haven.

Dentists.

DR. E. S. GAYLORD.
DR. R. F. BURWELL.

Miscellaneous.

REGISTER PUBLISHING CO.
POLICE OFFICE.
POST OFFICE.
MERCANTILE CLUB.
QUINNIPIAC CLUB.
F. V. McDONALD, Yale News.
SMEDLEY BROS. & CO.
M. F. TYLER, Law Chambers.

Stores, Factories, &c.

O. A. DORMAN.
STONE & CHIDSEY.
NEW HAVEN FLOUR CO. State St.
" " " "Cong. ave.
" " " "Grand St.
" " " Fair Haven.
ENGLISH & MERSICK.
NEW HAVEN FOLDING CHAIR CO.
H. HOOKER & CO.
W. A. ENSIGN & SON.
H. B. BIGELOW & CO.
C. COWLES & CO.
C. S. MERSICK & CO.
SPENCER & MATTHEWS.
PAUL ROESSLER.
E. S. WHEELER & CO.
ROLLING MILL CO.
APOTHECARIES HALL.
E. A. GESSNER.
AMERICAN TEA CO.

Meat & Fish Markets.

W. H. HITCHINGS, City Market.
GEO. E. LUM, " "
A. FOOTE & CO.
STRONG, HART & CO.

Hack and Boarding Stables.

CRUTTENDEN & CARTER.
BARKER & RANSOM.

Office open from 6 A. M. to 2 A. M.
After March 1st, this Office will be open all night.

Report of High Speed Electric Railway Work.

BY O. T. CROSBY, BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, FEBRUARY 24, 1891.

The experiments here reported were the first serious efforts ever made to at once double railway speeds, and as such should, I think, be systematically recorded. They were made for the Electro-Automatic Railway Company, of Baltimore, Md. This company was organized about four years ago by Mr. David G. Weems, who, though not an engineer, was convinced that the electric motor would give very high speeds for the transportation of parcels. His persevering enthusiasm resulted in inspiring a number of gentlemen to subscribe money for the venture.

Mr. Weems first contemplated having an entirely automatic service from city to city, the cars to be smaller than would be necessary for placing a man.

For purpose of demonstration, a circular track nearly two miles in circumference, was laid at Laurel, Md.; gauge 28 inches, weight of rail 16 pounds, shape T, cross-ties 3x4 inches square, 16 inches apart. Wooden stringers 3x4 inches were laid outside each rail, serving as guards. Mud-sills 3x4 inches were laid under the ties, and to the ties was built up a vertical frame-work on both sides of track, this carrying from cross-pieces 2x6 inch wooden stringer, suspended above the middle of the track, while to the lower surface of the stringer was attached a small T rail, head down. This upper rail was intended to serve as an electric conductor, and also, in connection with upward pressing wheels, as a guide. The latter function was not successfully performed, the lateral oscillation of the car, on so slight a track, being too great. Part of the track was on trestle work crossing a swamp, the overflow of which caused frequent wash outs.

The locomotive was very simple. Three axles carried 28 inch wheels; on these were hung a steel box, 16 feet long by 24 inches high by 30 inches wide. A slight vertical play of the box was provided for by springs, but, horizontally, the three axles were in rigid connection. On each of these axles it was designed to place a motor. The head was pyramidal; the weight of the car with three motors was about three tons. A second similar box of steel was made to be drawn by the motor car, the two to be connected by a ball and socket arrangement, the interval between cars to be flanged over so that only one surface should be presented to meet atmospheric resistance. The tail was pyramidal. The second car was not in use more than once.

The track-work and cars were completed as above outlined when the matter was brought to the Sprague Electric Railway & Motor Company, with the request that they design motors of which the armatures should be placed directly on the three driving axles of the car, the construction of which was already nearly finished. It was further conditioned that the motors should do 20 horse-power of work each, at a normal speed of about 3,000 revolutions per minute. This corresponds to a car speed of about 250 miles per hour. Needless to say, that on so light a track, none of which was straight, and with a car weighing three tons, and with only 60 horse-power available for work, no such speed was attained. The motors were carefully designed by Mr. H. F. Parshall, of the Sprague Company, for a normal impressed electro-motive force of 500 volts, and thoroughly filled the specifications. They were to be connected in multiple across the 500 volt circuit supplied with current from a dynamo made by the Edison Machine Works. When the motors were finally mounted and ready for action, it was found almost impossible to start the car, due probably to stiff bearings, and when several trials of speed had been made, the results were disappointing.

Up to this time the electrical work had received only such engineering attention as could from time to time be given by employés of the Sprague Company, much occupied in other ways. It became evident to the Baltimore Company that any satisfactory accomplishment could be had only through the continuous attention of some one having had electrical experience.

As superintendent of the Sprague Company, I had been familiar with the manufacture of the motors, and had moreover visited the plant; hence in October, 1889, it was arranged that further experiments should be under my direction. Throughout the work, Mr. B. J. Dashiell, Jr., M. E., and Mr. H. F. Purdy, of the Sprague Electric Company, were of constant assistance both in conception and execution of all that was done.

Work having been resumed, it was soon found that a given speed could be attained with less current if two motors were in service than with three, and, consequently, the motor on the middle axle was removed. It seems probable that, when running, this middle motor was largely occupied in skidding the wheels driven by it, since the two outer axles, on a yielding track, would doubtless support the greater part of the weight. In any case, the two motors were able to produce a greater speed than the track could stand. These machines were of the U type. The armature was wound with 100 sections of No. 12 B. W. G. wire, each section of two turns. This armature, with its commutator, was rigidly mounted on the axle. The pole-pieces were attached to brackets centered on the axle, the keeper was spring-supported on cross-piece carried by the steel casing. Bearings were of phosphor-bronze and lubrication by oil from an ordinary cup. No trouble on this score was experienced. Each magnet core was wound with 120 turns of No. 4 B. W. G. wire. At 30 amperes the armature induction was about 80,000 lines per square inch. Outline of the motor is shown in Fig. 1. These motors, since wound, according to specification, for the 500 volt circuit, were originally connected in multiple arc. This connection was changed, they being placed in series, thus diminishing the potential-control required at the station, by reason of the fact that the machines were run at a speed so much below that for which they had been calculated.

To supply the current, contact was made between the upper rail and brushes of sheet copper set against the rail by springs. These served their purpose well. The return circuit was through the wheels and rails, the steel casing being insulated from the axle by fibre plates and washers at joints and bolts. Rail bonds (covering joints in upper and lower rails) were used throughout; the resistance of the external circuit from the feeder junction to a point diametrically opposite was about 0.25 ohm.

The station was placed inside the circle, about 200 feet from the track. The generator was a 70 horse-power Edison machine, not compounded originally, and was driven by a 90 horse-power high speed Ball engine. At first a wire resistance of about 12 ohms was used to lower the potential on the line, as it was not convenient to run the dynamos at less than 400 volts. Later, a whiskey barrel was filled with water, an iron plate, eight inches square was placed in the bottom, a similar plate was fixed to the end of an iron rod and this rod attached to the pulley, permitting easy lifting or dropping of the plate through the water. These plates being connected in the main circuit, a very serviceable liquid rheostat resulted, which, when "taken with a grain of salt," answered excellently the purpose of regulating currents which often went as high as 150 amperes.

The usual course of a run was this. Speed-observers, as many as could be had, up to five or six, were stationed around the circle, distance apart being known. Watches of these observers and of recorders who read current and potential were compared. Potential readings were taken at station and at one or two points on the line, permitting easy reduction to horse-power. Mr. Dashiell, my assistant, then took the engine and I managed the dynamo. A current of from 20 to 40 amperes usually started the car. The size of the armature wires limited to about 90 amperes—45 in each machine—the current permissible for any length of time. This value was usually attained in the first half mile of run, a considerable part of the external resistance having been cut out. When the car had attained a speed of 75 to 100 miles per hour, the line potential was in the neighborhood of 450 volts, the iron plates in the barrel being in contact, having been slowly approached as the counter electro-motive force increased. The time limitation of the runs was invariably caused by failure of the track to serve its purpose. On three occasions the car left the track; once at 45 miles per hour, once at 80 miles per hour, and once, the last time, at about 115 miles per hour. Curiously enough, on the two former occasions the derailment was to the inside of the circle, super-elevation being about four inches.

It was easy to tell in the station when a derailment was imminent, as the ammeter was most violently agitated by the make and break of the circuit caused by the particularly bad spots in the track. The agitation increased with each trip round the circle and ended in a run off, or, after some experience had been gained, in a cessation of the trial. As the track limited the length of run in time, so also it limited the speed obtainable. Each trial—the longest being about 22 minutes consecutive running—was followed by an overhauling of the track, requiring from a few hours' to a week's work by four or five men.

Could the experiments have been made on a road-bed and track, deemed even second-class according to steam railway standards of rail weight, etc., there can be no question that without any other change the car could have maintained for several hours a speed of 120 miles per hour. Indeed, I know of no time limitation that would have arisen save that from a limited oil supply.

The speed obtained in the first round—that is, in the first 9,240 feet—varied from 30 to 75 miles an hour; this was determined by

the management of the rheostat. The *rate* of acceleration from point to point in going round the circle was irregular, due to the grades, which, going in the direction usually followed, varied from 2.0 to 2.5 per cent.

The fact that the track—always bad—went rapidly from bad to worse during each run, made it difficult to analyze the records with a view to determining the true coefficient of traction. Moreover, the coefficient for such a track, even in its best condition, would be greater than for the track that would necessarily be built for actual service. The figures obtained were of little worth as far as fixing absolute values at very high speed, but at least served to show the error of many train resistance formulæ found in the text-

Av'ge speed = 8,800 F. P. H. = 100 M. P. H.
" horizontal effort = 44 x 33,000 ÷ 8,800 = 165 lbs.
" " " for atmospheric work—48 "
" " " for other work = 117 lbs.
" " " per ton = 117 ÷ 2.4 = 48 lbs.

Highest speed attained this run—110 to 120 M. P. H. Track better than in last run, but car was derailed at maximum speed.

These values, 46.0, 42.5, 50.0, 58.7 and 48.0 lbs., should be corrected for curvature, making them, 30.7, 28.4, 33.4, 39.1 and 32 lbs., respectively. Other and lower values were obtained when the track, as at first, was in better condition. But these earlier runs were not recorded in exact figures. The rails were in all cases rusty.

The maximum speed—that of final derailment, given above, could not be absolutely de-

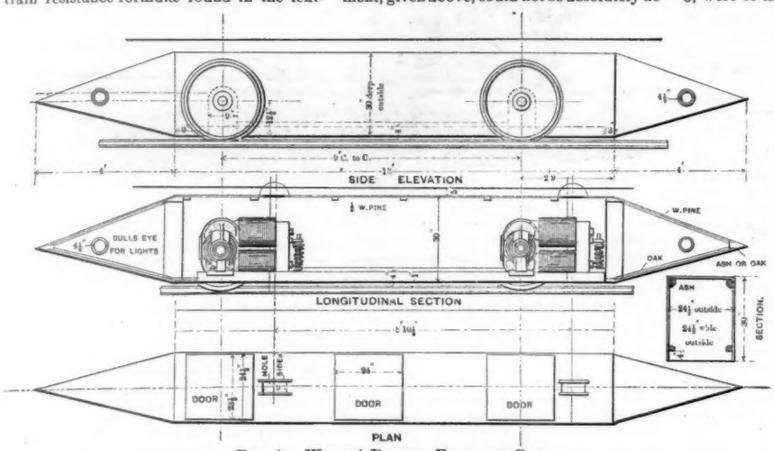

FIG. 1.—WEEMS' PARCEL ELECTRIC CAR.

books. Some of these formulæ give good enough results when used for the low speeds on which they are based, but their algebraic form is such as to give rise to great error when higher speeds—say 80 to 120 M. P. H.—enter. This whole matter of train resistance has been more fully treated in a paper, "Limitations of Steam and Electricity," read by me before this Institute on May 21, 1890. The particular element of atmospheric resistance, for which special experiments were made at Laurel, was fully treated in a paper read by me before the West Point branch of the Military Service Institute, and published in London *Engineering*, issues of May 31 to June 13, 1890.

Using for atmospheric resistance, figures resulting from the experiment herein referred to, we may analyze thus:

RUN OF OCTOBER, 1889.—FLAT HEADED CAR.

Time of 1st round, 3.8 minutes. Av. speed=2,430 F. P. M.=28 M. P. H.
Time of 2d round, 3.8 minutes. Av. speed=3,300 F. P. M.=37.4 M. P. H.
Average rate of work done by motors in 2d round=15.0 H. P. 495,000 ft. lbs.
Average horizontal effort in 2d round=495,000÷3,300=150 lbs.
Average horizontal effort in 2d round for atmospheric resistance=30 lbs.
Average horizontal effort in 2d round for acceleration (approx.)=10 lbs.
Average horizontal effort in 2d round for other resistances=110 lbs.
Average horizontal effort in 2d round per ton=110÷2.4=46 lbs.

RUN OF NOVEMBER 13, 1889.—FLAT HEAD.

Time of 1st round=4.25 minutes. Av. speed=2,170 F. P. M. = 24.7 M. P. H.
Time of 2d round = 2.5 minutes. Av. speed = 3,700 F. P. M. = 42.0 M. P. H.
Time of 3d round = 2.5 minutes. Av. speed = 3,700 F. P. M. = 42.0 M. P. M.
Av. rate of work from middle of 2d to middle of 3d round = 15.5 H. P. = 511,500 ft. lbs.
Average horizontal effort = 511,500 ÷ 3,700 = 138 lbs.
" " " for atmospheric work = 36 lbs.
" " " for acceleration = 0 lbs.
" " " for other work = 102 lbs.
" " " per ton = 102 ÷ 24 = 42.5 lbs.

RUN OF NOVEMBER 13, 1889.—PYRAMIDAL HEADED CAR.

Time of 1st round = 4.0 minutes. Av. speed = 2,410 F. P. M. = 26.2 M. P. H.
Time of 2d round = 2.0 minutes. Av. speed = 4,620 F. P. M. = 52.4 M. P. H.
Time of 3d, 4th, 5th and 6th rounds = 2.25 minutes. Av. speed = 3,678 F. P. M. = 41.8.
Average rate of work in last four rounds = 16.0 H. P. = 528,000 ft. lbs.
Average horizontal effort = 528,000 ÷ 3,678 = 144 lbs.
" " " for atmospheric work = 24 lbs.
" " " for acceleration = 0 lbs.
" " " for other work = 120 lbs.
" " " per ton = 120 ÷ 2.4 = 50 lbs.

RUN OF DECEMBER 3, 1889.—PYRAMIDAL HEADED CAR

Time of 1st round 4.3 minutes. Av. speed 2,070 F. P. M. = 23.5 M. P. H.
Time of 2d round = 1.51 minutes. Av. speed = 6,120 F. P. M. = 70.0 M. P. H.
Average rate of work in 2d round = 41 H. P. = 1,353,000 ft. lbs.
Av'ge horizontal effort = 1,353,000 ÷ 6,120 = 221 lbs.
" " " for atmosp'ric work = 38 lbs.
" " " for acceleration " = 42 "
" " " for other w'rk 221—80 = 141 "
" " " for ton = 141 ÷ 2.4 = 58.7 "

The highest speed attained in this run was 90—95 M. P. H.; track was very bad, car derailed.

RUN OF DECEMBER, 1889.—WEDGE HEADED CAR.

Speed maintained at 100 M. P. H. with rate of work = 44 horse-power. Moreover, some work of acceleration was done, but records do not permit accurate determination of this. Omit acceleration, and we have:

termined, since the car left the track at some distance from the last two observers, whose time records gave the speed attained between the points of observation. It was clear, however, that final speed was between 110 and 120 miles per hour. A length of 1,000 feet of track was injured, about 300 feet of the upper framework wrecked, and the car itself was landed about 30 feet from the track, having finally jumped the guard rails while going over a fill four or five feet high. It seemed clear that the Laurel plant had passed its days of usefulness. Nothing further of value could be done without practical rebuilding. It was then time to make new plans, and this work was at once begun by Mr. Dashiell and myself. At the outset I felt that, if for no other than commercial reasons, we should plan for the carrying of passengers as well as parcels. This meant an increase in the size of cars, and a change from an attempt at automatic control to control by human intelligence on the locomotive.

For purposes of demonstration I proposed to the company that they should build a track about four miles (not less) in circumference, and should run thereon a train of two or three cars, drawn by one locomotive. Calculations were based on the following data:

1. A speed of 150 miles per hour on a level was to be aimed at.

2. Cross-section of car should be a minimum consistent with the seating of passengers. This was taken at six feet by five feet, 30 square feet (crowning higher along middle of car).

3. Gauge of track should be standard four feet, 8.5 inches.

4. Character of track should be simply the best that art could contrive, rails to be from 65 to 90 pounds.

5. Electro-motive force should be as high as the art of insulation would permit.

6. Whatever might be the number of cars in a train, all were to be so connected as to present a continuous exterior, thus presenting only one cross-section to the atmosphere.

7. Atmospheric resistance at 150 miles per hour would be taken at 15 pounds per square foot of cross-section, a wedge or parabolic locomotive head being used. This value is 50 per cent. in excess of that indicated by our experiments.

8. Traction coefficient, exclusive of air resistance, would be taken, at 150 miles per hour, to be 25 pounds per ton—this for reasons set forth in previous papers.

From the two resistance coefficients just given, it followed that for every square foot of cross-section, regardless of weight, six horse-power would be required, and for every ton of weight, regardless of cross-section, 10 horse-power must be supplied.

For a locomotive of about 600 horse-power having 30 foot cross section, the dead weight was calculated to be about 18 tons. Steel cars of equal cross-section were designed, weighing, empty, about five tons, with carrying capacity of about five tons.

The important question as to power required could then be thus tabulated:

	150 M. P. H.	120 M. P. H.
Locomotive alone	360 H. P.	288 H. P.
Locomotive and one car loaded	460 "	369 "
Locomotive and two cars loaded	560 "	446 "
Locomotive and three cars loaded	660 "	528 "

To perform the work here indicated two motors were provided, one armature directly on each of the two axles of the locomotive car. These motors, outlined in Figs. 2, 3, 4, 5, were of the Manchester type. They were supposed to be at first connected in arc across a 1,500 volt circuit, each taking about 130 to 150 amperes and delivering about 250 to 300 horse-power. Should it be desired to experiment with higher line potential, the motors in series would permit 3,000 volts to be easily tried. The armatures of the Gramme type are 30 inches outside, 23 inches inside, diameter. The armature conductors were to be of about 40,000 circular mils cross-section, or from 500 to 600 centimetres per ampere. Many successful machines, designed to work indoors, go as low as this figure, and since the dissipation of heat must in such case proceed more slowly than in the case here considered, the figure seemed very safe. Moreover, it was intended to introduce a blast of air from the car front which should continuously flow through the open center of the armature (Gramme type). How far the rate of dissipation would be carried by such means can not now be known, but all recent evidence (see experiments of Mr. Kennelly) goes to show that the heat capacity would be much increased.

The cross-section of core in the armature was 3.5 inches by 40 inches, equalling 140 square inches gross, or, deducting 15 per cent. for paper insulation between disks, and eight per cent. for conductor slots cut in periphery, 110 square inches net. Through this armature it was desired to force 22,000,000 lines (C. G. S. units) or 100,000 per square inch, equalling 15,200 per square centimetre.

The hysteresis loss in such an armature, revolving at 2,200 R. P. M. (equivalent with 42 inch wheel to 150 M. P. H.), was calculated to be about 3,000 watts—following the curve published by Esson. The C^2R loss (C=135 amperes, R=0.26 ohms when T=75° C.)=4,740 watts—or about 8,000 watts for the two losses. I found it difficult to obtain such coefficient as would give reliable values for loss due to Foucault currents. With very thin plates it would not be large.

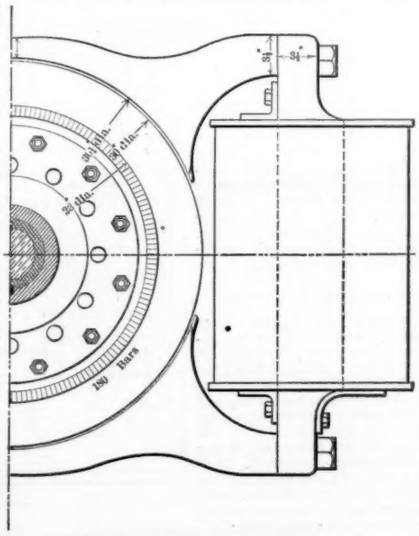

FIG. 2.—HALF END ELEVATION OF MOTOR.

From what precedes, it followed that the number of armature conductors should be 340. These were divided into 170 sections, wound in one layer, each conductor to lie in a slot; both slot and conductor were planned to be rectangular, or nearly so, with the reservation that experience in manufacturing would soon show the proper detail.

The magnets have a cross-section of 164 square inches through which 14,300,000 lines of force must pass, the increase from the number in the armature being determined by a leakage coefficient 1.3.

The magnet coils of the two armatures were calculated to be in series with each other, but in shunt with respect to the two armatures. This variation from present street car practice I thought to be justified by the following considerations: First, no system of commutation could obviate the need of a considerable external resistance, which then could be easily made sufficient, within itself, for speed control; second, the maximum torque for a given armature current is always desirable and can be best obtained by permanent saturation; third, this constant and maximum magnetization would tend to diminish sparking—an evil to be specially avoided in long distance work, involving continuous runs of several hours.

While it was thus intended to use shunt coils at first, I felt that a little experience would soon positively demonstrate that the advantage lay with this or the series winding.

The commutator, Fig. 5, was designed to be 23 inches in diameter, which would, of course, give rise to a very high speed relative to the brushes. I believed it better to face the mechanical trouble that might be connected with great circumferential speed rather than to diminish the diameter by decrease of sections, since this in turn might produce sparking.

Without going into the mechanical detail of the commutator, I may add that a single bar could be taken out or replaced, without removal from the shaft.

The rheostat for the armature circuit was designed to be of iron wire, with the expectation, however, of experimenting also with liquid or carbon resistance. The resistance and heat capacity of this main line rheostat were determined with reference, first, to current necessary for starting; second, to currents needed for maintaining low speeds. The starting current on practically level track was calculated to be from 300 to 400 amperes, the load being 80,000 pounds (or locomotive and three loaded cars). For continuous running at 30 miles per hour, a current of 40 amperes would be required, the counter electro-motive force of each of the 1,500 volt motors being, at this speed, only 320 volts. The line-potential being 3,000 volts, it would be necessary to have in the armature circuit an external resistance of 59.0 ohms $= \frac{3000-640}{40}$. The wires were calculated to stand 40 amperes continuously, and the various sections were proportioned to stand various currents for such time as would serve to bring the train up to speed. It was, of course, known that a considerable reduction in the size of resistance box could be effected by winding the motors for the regular line potential, thus normally working them in arc, but putting the armatures in series where a great reduction in speed might be required.

A small rheostat and a condenser were designed to be placed in the circuit of the magnet coils, and a rheostat also in the lamp circuit, these resistances giving delicate control.

The problem of retardation for a mass of, say, 40 tons running at 150 miles per hour is a serious one. The Galton and Westinghouse tests indicate a very low value for the coefficient of friction between brake-shoe and wheel at high speeds; they report it in some cases at 60 M. P. H. as low as 0.04. As, however, it rapidly increases at lower speeds, an average of 0.1 may be taken. The total retarding effort, *i. e.*, brake resistance and track and atmospheric resistance, must be kept below that which will just produce sliding of the wheels, and the coefficient of sliding may be taken on an average at 0.08 of the weight of the wheels. If, then, we represent by P the maximum allowable brake pressure on the wheels, by R resistance other than brake friction and by W the weight on braked wheels, we may write the following inequality:

$$0.1\,P + R < 0.08\,W.$$

The value of P should be determined as that which, with a small margin, will satisfy this condition of inequality.

Following this calculation it was found that a brake pressure of about 5,000 pounds should be applied to each wheel. This was designed to be produced by magnetic brakes similar to those used by Mr. Daft on the New York Elevated Railway. The form and approximate dimension of those brakes are shown in Fig. 6.

A mass of 80,000 pounds moving at 150 miles per hour represents 64,000,000 foot pounds of energy. Average resistance due to brakes = 0.1 x 60,000 = 6,000 pounds. Average resistance from track and atmosphere for average speed of 75 miles equals 400 pounds.

In addition, the motors may be required to generate a current which shall be wasted over the rheostat. Since the field circuit, in the case of shunt motors, is independent, magnetization may remain constant, and average electro-motive force of 1,500 volt motors (*i. e.*, motors generating 1,500 volts electro-motive force at 1,100 R. P. M., or with 42 wheels at 150 electro-motive force) would be, while the train was coming to rest, 750 volts. Make the external resistance such that, the two armatures being in series, an average current

of 200 amperes shall flow. Then average dynamo resistance, in pounds — 2,000. Total retarding effort — 6,000 + 400 + 2,000 = 8,400 pounds. Dividing 64,000,000 by this last quantity we have 7,620 feet as the length of run to come to a stop, and the time of stopping about 100 seconds.

For the mechanical construction of the locomotive, two plans were contemplated. One has a 12 foot rigid wheel base and no pilot wheels; the other has a seven foot wheel base for the drivers and a pony-axle in front, free to move laterally over a certain distance, dragging the drivers in the same direction. This is the general principle of pilot wheels, so largely used on high speed engines. This second arrangement is preferred. In it nearly all the weight goes on the drivers. In this particular case, total weight of locomotive is about 18 tons, each motor being six tons. Of the total, 15 tons rests on the drivers. If, then, the adhesion coefficient, while running, be taken at only 0.1, a circumferential effort of 3,000 pounds may be exerted without slipping the wheels. This is safe, since if 600 horse-power of work be required at 150 miles per hour — 13,200 F. P. M., the horizontal effort — $\frac{600 \times 33,000}{13,200}$ — 1,500 pounds. For starting the load, adhesion co-efficient may be taken at 25, giving 7,500 pounds possible pull, this being much in excess of the value required.

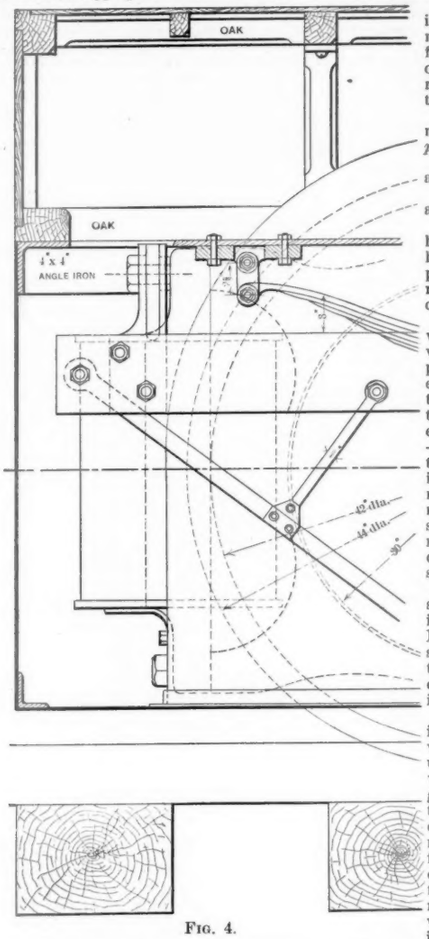

FIG. 4.

The locomotive construction is such as to put the entire weight of the armature directly on the axle. In designing this, I did not overlook the fact that the armature must thus be subjected to much jarring. But I believe the difficulty should be met by excellent mechanical construction, rather than that spring movement should in any way be attempted. For mechanism that shall succeed in high speed, long-time service, simplicity is a requirement of the first order. Indeed, generally, in this work of connecting an electrical motor to any vehicle, I have long felt that he who is over-ingenious in contriving many parts and fine adjustments, may not be over-successful.

The weight of the magnets and pole-pieces goes also directly on the axles, save for the intervention of rubber plates having a maximum play of $\frac{1}{16}$ of an inch. By the use of motors of the U type, part of the weight might be spring supported, but, on the other hand, it is not as easy with that type as with the Manchester to obtain a perfectly sparkless motor. Moreover, the weight going dead on the axles in the case considered, is not greatly in excess of that due to eight-foot drivers and other attachments of large steam locomotives. Further, the need of any spring movement decreases with increasing perfection of track work; as, in ideally perfect track, car springs would not, save on curves, come into play.

In the first design of locomotive cars, the operator is to sit between the two motors, where also would be placed the controlling devices. In the second design, the operator would be placed over the pony-axle, the devices being chiefly in the cylindrical or parabolic head.

Detailed drawings of freight and passenger cars were completed, but need not here be referred to.

As to the supply of current, it is proposed to use the double metallic system. This departure from the ground return, now so commonly employed in street railway work, seems justified by the following considerations:

1. For a given voltage, it diminishes the cost of insulation, *per se*.
2. It diminishes the danger of accident within the motors.
3. It diminishes the danger of accident to workmen.
4. By being thus more easily handled, it is probable that a higher voltage will be found practicable than with the ground return; hence, in fact, even first cost might not be greater.

As designed, the conductors will be placed in an inverted wooden trough, attached to posts placed at 12 foot intervals on each side of the track. The trough to be about 5.5 feet above the ground. The conductors for each side of the circuit to be two —one insulated and continuous; the other a bare, flat strip, broken into sections, these being normally out of circuit; the locomotive trolley arm operating a switch which shall throw out the rear section and throw into circuit the section head. Such a switch was designed in detail.

As to what the line of voltage should be, progress in the art of insulation can alone determine. It would, of course, not be necessary, on a roadway for long distance travel, to consider the death-producing voltage as a limitation.

In the important matter of limiting curvatures, calculations were made in the ordinary way, using the particular values for weight and height of center of gravity. A safe speed was then tabulated as that which is just one-half the speed that causes the resultant of weight and centrifugal force to pass through the outer rail of a curve. The beneficial effect of super-elevation, neglected in the calculation, would, of course, practically increase the factor of safety.

The following table resulted from method described:

Radius in feet.	Safe speed, by rule above, in miles per hour.
1,000	71
2,000	98
3,000	120
4,000	140
5,000	158
6,000	172
7,000	187
8,000	198

Of course, naught save practical trial could determine whether the assumed factor of safety, which is quite large enough at present speeds, would, in fact, be right for the higher speeds aimed at.

COMMERCIAL ASPECTS.

Copper calculations were made, based on a station potential of 3,000, and also of 6,000 volts, stations being 50 miles apart (thus supplying current 25 miles on each side) and on a service requiring one train on each 25 mile section, the drop on the line being 33 per cent. of station potential. Then for a line of 1,000 miles, as from New York to Chicago, with copper at 15 cents per pound, and for 3,000 volts initial:

	PER MILE.
Cost of conducting system, including frame work	$7,000.00
" station per mile, including steam	3,000.00
" double track, including depots, etc.	55,000.00
" train equipment, 3 cars each, 50 trains and engines	1,000.00
Total per mile	$66,000.00

In this the cost of track construction is based on road-bed figures reported for the Erie Railway Company. To arrive at operating expenses, suppose 20 trains each way each day, and a schedule of 125 miles per hour, *i. e.*, eight hours for the trip. Suppose a station development of 800 horse-power per train on the line, or 64,000 horse-power hours per trip. In stations of large capacity working under the supposed conditions, the cost of one horse-power hour — 0.90 cent (see tables in previous paper "Limitations of Steam and Electricity"), or per trip for power a cost of $57.60. For train men, supppose two men on each train and one per train in reserve, and suppose $3.00 per man per trip of eight hours, then, cost per train trip—3, ×3—$9.00. Interest charge per train trip —$66,000,000 × 0.05 ÷ 365 × 40 —$225.42. For maintenance of way (see Wellington's Statistics), take $1,000 per mile of double track per annum, or per day for supposed line $2,700 per trip, or 2,700 ÷ 40 — $67.50. For general expense of operating company, suppose $1,000 per day, or per train trip $25. For wear and tear, oil, etc., on train itself, take $10 per trip. Then total —56.60 + 9 + 225.42 + 67.50 + 25 + 10 — $394.42.

For receipts:

Suppose average train be of two cars (such as designed), having each a capacity of about 10,000 pounds freight (considered such as express and mail matter), or of, say, 15 passengers. Suppose average train load of freight, 15,000 pounds, of passengers, 20. Take freight at 33 cents per cwt., passengers at $25. The income per trip in either case, $500, showing profits, over fixed charges, of, say, $100 per trip, or $4,000 per day. The total daily load of freight, each way, required to justify the service above treated, is 300,000 pounds, or if 200 through passengers be carried (*i. e.*, 10 trains for passengers each way each day) then only 150,000 pounds of freight. The *present* movement between New York and Chicago, in mail and express, is not far from this figure. A 500 mile line, connecting Boston, New York, Philadelphia, Baltimore and Washington, would be even more profitable. It is to be remembered also that a service of *small* trains is contemplated, making fixed charges relatively very large. Much larger trains could be, and I think *will* be, run at the speeds here considered, but I have supposed that the smaller effort would precede the larger. It is further to be noted that the use of 6,000 volts potential, and the extension of some existing roadway instead of the building of a new one, would diminish first cost. As grade-crossings would be out of the question, and as cities would require to be entered above or below the surface (country roads to be carried over on bridges), it is, perhaps, best to consider only the larger figure already used.

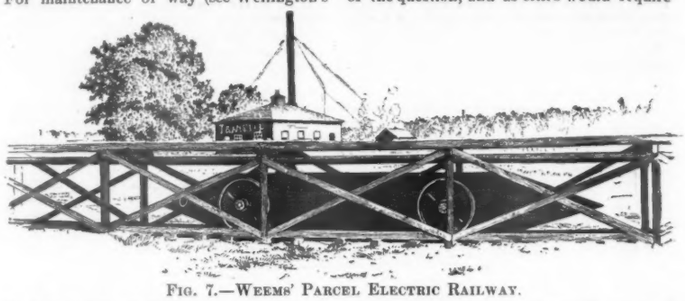

FIG. 7.—WEEMS' PARCEL ELECTRIC RAILWAY.

To demonstrate all, or nearly all, that has been outlined in this paper will cost about $300,000, covering the construction and operation, for a reasonable time, of the four mile circular line proposed above. Last year the Baltimore company met unexpected difficulty in efforts to raise the needed money; their operations were suspended and my connection with them ceased just at the time when plans were completed—even to working drawings. I have been much pleased to learn, within the last few days, that, far from being discouraged, they are now confidently hoping that they may push on, in the near future, the great work to which they have laid their hands.

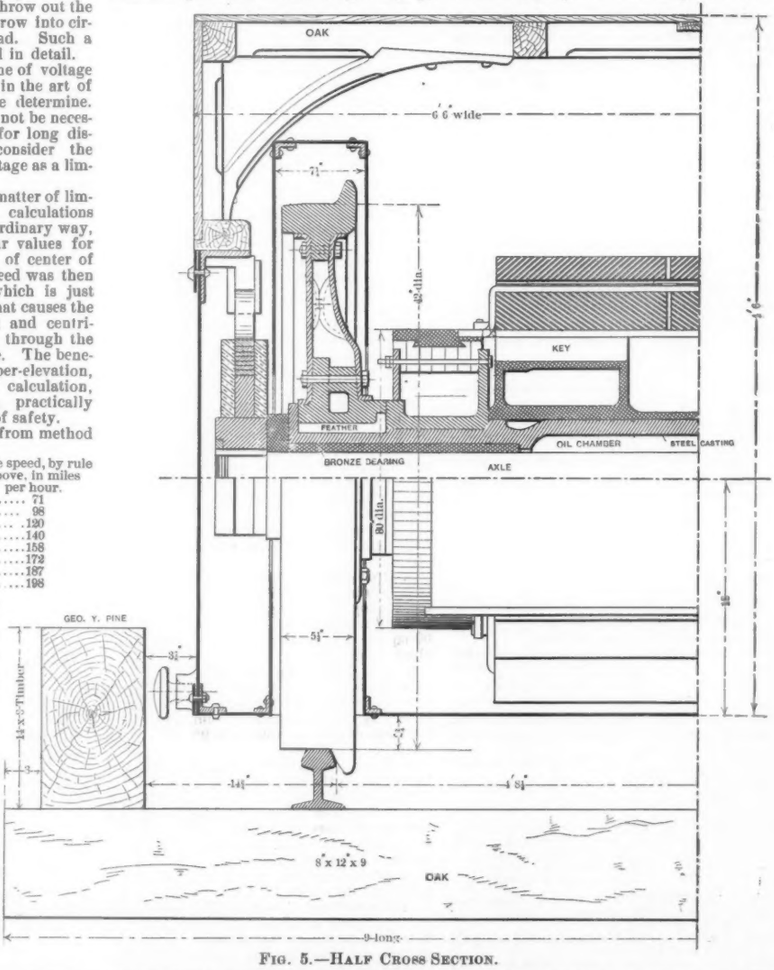

FIG. 5.—HALF CROSS SECTION.

Unfamiliar as is the project, you will, perhaps, be the more ready to share the confidence of its promoters on hearing the words from Prof. Henry A. Rowland and Dr. Louis Duncan, of Johns Hopkins, to whom were submitted, last Spring, full details of the plans partially described in this paper. After reviewing the figures for power required, they say:

"We believe from the data obtained that the values given are not too low, and that the horse-power which Mr. Crosby calculates is *not less than the amount required. We believe that the value assumed by Mr. Crosby is safe.*"

"The motors, the calculations and drawings for which are in the appended statement, will develop the horse-power for which they are designed, namely, 500 horse-power. We point out some modifications which will be beneficial. *We believe that they will drive the train* (locomotive and two cars, O. T. C.) *at the required speed.*" (Italics here and elsewhere are mine, speed then considered 120 on a level, O. T. C.)

"The possibility of a train being derailed by an obstruction on the track increases with the speed. At speeds up to 90 miles, however, there seems no increase in the number of derailments. In the case in question, the center of gravity of the cars is very low, and *it would be difficult to derail them on straight parts of the track.* The radius of the curves should, of course, be great, but not so great as would be required for an ordinary train going at these high speeds. *The question of safety is, however, almost wholly a question of track construction.* As these latter have several times made 86 miles, and often made 80 miles, *it would seem that a speed of 120 miles, or even more, with the electric cars would not be outside the limits of safety.*"

"The plan for supplying current to the motors is feasible."

"The design of the motors is discussed in the detailed report. It is generally good."

"Should it be demonstrated by an actual test that passenger trains can be run safely and economically at a speed over 100 miles per hour from here to Chicago, the financial aspects of the case would certainly be improved. *We are of the opinion that the chances are in favor of this being accomplished by the present scheme.*"

These words, though guarded and accompanied by criticism of the detail, are yet a substantial approval of what was submitted. To me they were very encouraging.

[Pressure of other business has prevented me from carefully reviewing the calculations appearing in this paper.—O. T. C.]

Electric Car Fenders.

The Boston *Evening Transcript* in a recent issue devoted considerable space to electric car accidents and their prevention by the use of fenders.

The conclusion reached is that the best form of life-guard should consist of two parts. First.—A frame in front of the platform, 15 to 18 inches from the rails and projecting as far as practicable, which, when a person is struck by an electric car, would give him something to catch hold of, and, perhaps, rest upon, and thus save himself from being run over. Second.—There should be some form of fender attached to the truck, to save a person lying on the track from getting under the wheels. The best form of such fender is a fixed tender attached to the truck; should be V-shaped, but with the point cut off square for a length of about 12 or 15 inches. The front of the fender should be securely braced vertically against an angle iron connecting the two sides of the truck, and it should extend as far in front of the truck as is consistent with rigidity and with being clear of the car when tilted. The fender should be as near the ground as is practicable, not over two and one-half inches above the level of the tops of the rails. It should have attached to its lower edge a continuous thick strip of rubber, or of rubber hose flattened and bolted to the wooden strip, and coming down still closer to the rails. The rubber should be brought down to within half an inch of the tops of the rails and should be stiff enough to aid in pushing before it any part of a human body which it might encounter, while if it came in contact with paving-stones or other rigid obstructions it would yield. The fender should either slant or curve backward from its outward edge.

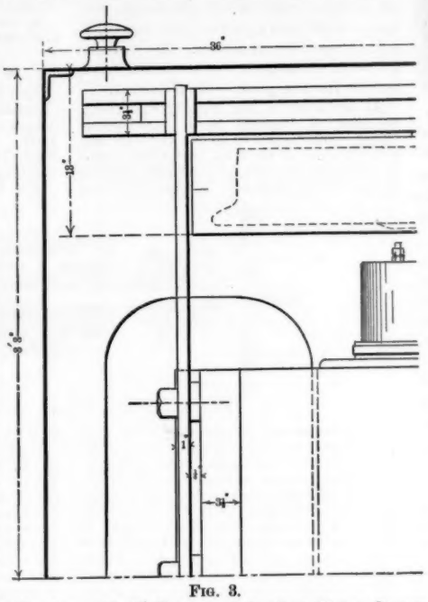

FIG. 3.

Stanley vs. Slattery.

A decision was given last week in the case of W. Stanley, Jr., formerly of the Westinghouse Electric Company, against M. M. Slattery, of the Fort Wayne Jenney Company. The contest was over the patent on the alternating current distribution with converters. The contest has been pending since 1888, Mr. Slattery claiming he held a patent prior to Mr. Stanley's, and there have been three appeals in the case. Last week Commissioner of Patents Mitchell called in his assistant, Mr. Fisher, and a decision was rendered, giving Mr. Stanley the right to use the converter system.

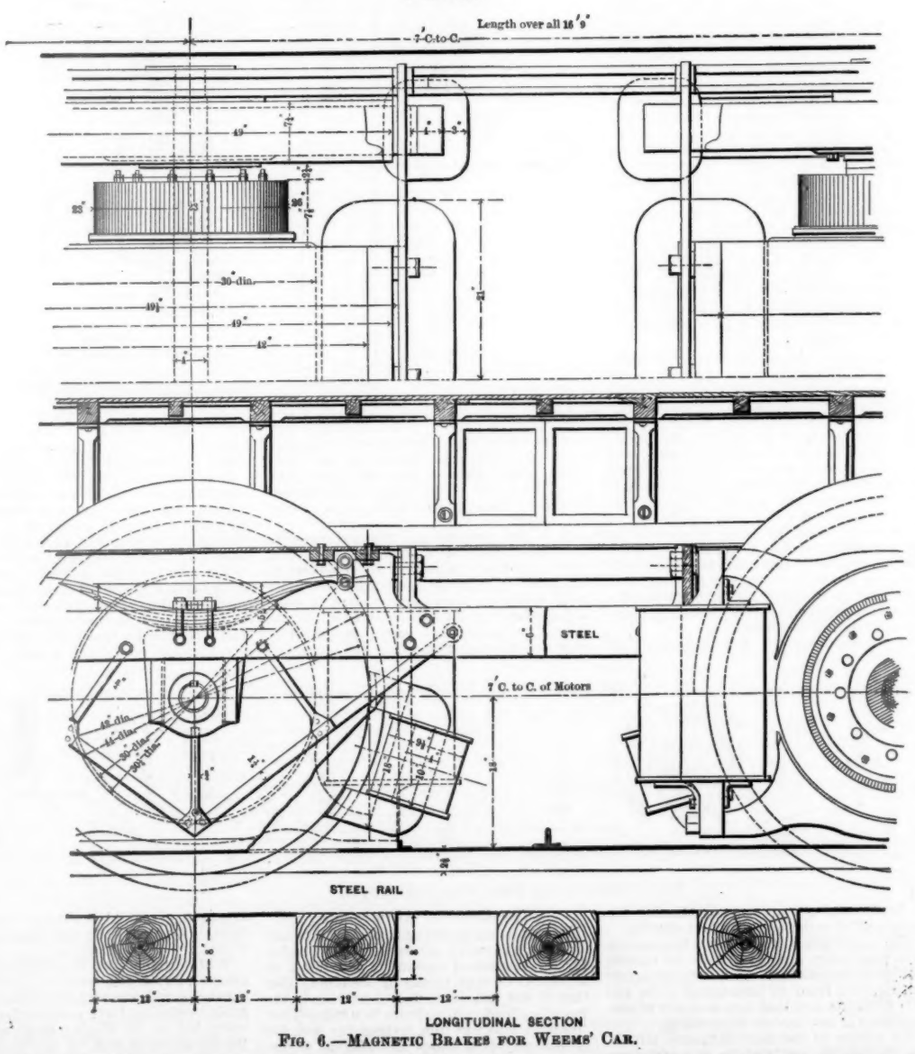

FIG. 6.—MAGNETIC BRAKES FOR WEEMS' CAR.

TELEGRAPHIC

.... The New Jersey Postal Telegraph Company has decided to give up its all-night service in Orange.

.... The Postal Telegraph Cable Company is rapidly extending its system in Denver under the management of William R. Benzie.

.... The Kings County Elevated Road, of Brooklyn, N. Y., which a few months ago made such an innovation by giving women positions as ticket sellers at the stations, has gone a step further, and it is learned that five telegraph operators will be replaced in a short time by female operators.

.... At the annual meeting of the Commercial Union Telegraph Company, of Maine, held last week, the following were elected directors: Henry S. Osgood, Fred. N. Dow, Albion Little, Stephen R. Small, of Portland; Henry Russell, E. J. Slatterly, Chas. E. Arnold, of Albany; James W. Wakefield, Bath; George C. Wing, Auburn; William D. Pennell, Lewiston.

.... At the annual meeting of the Postal Cable-Telegraph Company, of Pennsylvania, last week, the following directors were elected: A. B. Chandler, E. C. Platt, C. C. Adams, G. W. Dunn, W. L. Stanger. The following officers were elected: President, A. B. Chandler; vice-president, E. C. Platt; secretary, C. C. Adams; treasurer, G. R. Williamson.

.... Superintendent Gill, of the Western Union Telegraph Company, Philadelphia, has sent a communication to Postmaster Field, in which he states that tubes will be laid under Chestnut street from their new office, to be located at Tenth and Chestnut streets, to the various newspaper offices, and the post-office department is welcome to use the trench to be excavated in which to put tubes to connect the sub-post-office, on Chestnut above Third, with the principal office.

.... Judge Clifford, of Chicago, has sustained a demurrer of the Great Western Telegraph Company in several suits brought against stockholders to compel the payment of assessments levied against them. The stockholders entered the plea of fraud, and urged that the company never had any stock. The company's attorney filed a demurrer, which Judge Clifford upheld. Most of the stockholders that have been sued have deposited the amount of their assessment with a trustee, pending a decision in the case by Judge Tuley.

.... Americus has a wonder in the person of a boy telegraph operator. His name is W. H. Plunkett. He hails from Atlanta originally and is about 12 years old. This lad was turned out by the Western Union office in Atlanta. After leaving there he worked in the Atlanta office of the Central road, whence he was transferred to Opelika, then to Columbus, coming from that place to Americus several days ago. He makes a beautiful copy, and the fastest sender on the line is not too swift for him, while he is so much at home with the key that the best receiver in the railroad service cannot keep up with him when he lets himself out and goes to sending in earnest. Agent Maxwell feels that he has a treasure in young Plunkett.—*Atlanta, Ga., Constitution.*

The Direct Cable Company's New Quarters.

The Direct United States Cable Company has opened a special office at 21½ Spruce street, New York city, for the purpose of providing a greatly accelerated and more direct service for the numerous patrons of the Atlantic cables in the district familiarly known to New York business men as the "Swamp."

* * Canton and Massillon, Ohio, will be connected by electric street railroad.

* * Electric power is being adopted at the saw mills of Stockholm. One of the large engines will be used, and electric power will take the place of several smaller ones.

* * Last week fire in the street railway company's electric power house, at Sioux City, Iowa, damaged the building badly, and 14 motor cars and five passenger cars were destroyed. Loss, $30,000; fully covered by insurance.

* * The new street railway from Milford to Hopedale, Mass., equipped with storage battery cars by the Union Electric Car Company, which also has a road between Beverly and Danvers, will open this week, starting out with five cars.

* * The trolley system has gained a pretty fair foothold in Brooklyn, N. Y., several lines on the outskirts of the municipality and many to suburban points having been in operation for some time, and now an attempt will in all probability be made to introduce it on all the city lines.

* * The Newark, N. J., Electric Light and Power Company has elected for directors for 1891: John D. Harrison, Thomas T. Kinney, F. Wolcott Jackson, George W. Hebard, Gottfried Kreuger, Samuel Klotz, Charles H. Harrison, A. C. Denman, B. M. Shanley, James Stokes, Samuel S. Dennis, William Clarke, Philip N. Jackson.

* * After hearing some vigorous protests against the introduction of the trolley system of electric railroads, the Philadelphia council railroad committee last week unanimously agreed to report favorably a bill authorizing the Traction Company to put up poles and appliances for the operation of the system in West Philadelphia.

* * The magistracy of Berlin has recently passed an important resolution which affects the erection of electrical railways in the streets of Berlin. No concessions are to be granted for street railways which either are supported on columns (elevated railways) or when on the level of the street require supports to be erected in the roads or footpaths.

* * It must be apparent that present conditions cannot long continue in our street railway system. The roads are being operated at a very large loss, as a whole. It is evident that cable lines do not, and cannot, pay here; the example that one cable didn't earn half its cost before it was worn out—not to say anything about all the other great expenses of the line, the power, the cars, the men employed, etc., suggests how serious is that loss.—*Grand Rapids, Mich., Eagle.*

* * A citizen writes to the New York *World* as follows:

To an old railroader the *World's* criticism of the tunnel disaster and your suggestions seem to be appropriate and timely, but why would it not be better to "take the bull by the horns" and demand that trains in the city limits be operated by electric motors? This would at one stroke forever remove the greatest objections, viz., smoke, gas, steam and noise from the roads; and also provide a block system that would positively prevent the operation of more than one train on a section. London has a tunnel road in which the cars are operated very satisfactorily by electric motors. There are some 7,000 motors operating electric cars in this country, and many of them are on grades that steam locomotives cannot climb. It is well known to those versed in the art that the faster it is desired to have electric motors run, the easier the problem and the less mechanism required.

The Dahl Electric Motor.

Some 12 months ago a design for an "ideal" street railway electric motor was shown to a few gentlemen by Mr. Olof Dahl, an electrical engineer, of Pittsburgh, who has for more than a year confined himself to a line of special experiments. His work on a new electric motor is now about completed, and the REVIEW presents the following:

An armature of the ring type, of large diameter, is attached to a non-magnetic spider, which is placed on the car axle and is free to revolve thereon. Attached to this at one end is one-half of a peculiar friction clutch, whose other side is attached to the axle by means of a coiled spring. The field magnet and pole-piece of this motor are also somewhat out of the regular order of design. Placed on each side of the web of the spider are two magnet spools and cores, through the latter of which is free to revolve the hub of spider. Consequent poles are formed by said magnets on the interior and exterior of the armature and alternating in position, those on the outside being brought together and held in position with dowel pins and a yoke being bolted rigidly thereto, this yoke being fastened to the frame or truck to keep the field magnets from revolving. The whole motor will be protected from dust and other foreign substance by a brass case neatly arranged for accessibility. All fuses, connections and brushes are at the top of the motor and are accessible to the operator when he has opened a trap-door in the car and one of the slides in the casing. The clutch, which is one of the novel features, is composed of sheet-iron disks, each alternate one being fastened at its center or periphery. Those fastened at the center are attached to the end of spider of armature; those fastened at the periphery to the spring, as before mentioned, see Fig. 1 of the accompanying engravings. Rigid action is secured by pressing the sheets together by springs interposed in such a manner that at a predetermined pull on the clutch it slips and allows the armature to revolve faster than the axle, saving the motor from damage by excessive current. A very important matter in so compact a motor is lubrication. This has been amply provided for. The armature is so constructed that each individual section can be replaced without disturbing the others, should it be needed.

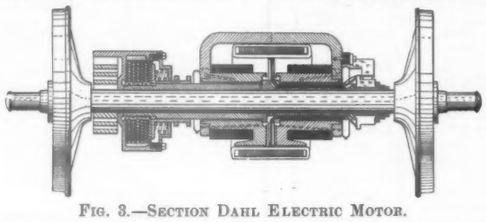

FIG. 3.—SECTION DAHL ELECTRIC MOTOR.

Owing to the absence of gearing or other speed and power reducing devices, a 10 horse-power motor of this kind is claimed to be ordinarily fully capable of performing any or all work now being performed by motors developing 15 mechanical horse-power and, in the moment of starting, this motor is said to be capable of easier working at higher efficiency than the old type motor. Dispensing with the gearing ordinarily employed relieves the motor of much useless effort which must be spent in overcoming the mechanical resistance offered by such gearing. Other claims made are as follows:

By the use of the clutch mentioned, it is impossible to overload the motor beyond a predetermined point, thereby avoiding burning of armature and field.

By the use of the clutch the armature may be kept running continuously, having the advantage of easier and smoother starting.

The construction of the motor is such that it is practically iron-clad, with no outside leakage of magnetism. This is an important feature, both from an economical point and also from the fact that the watches of passengers will not become magnetized.

By reason of the short magnetic circuit, the utilizing the inside of the ring armature, the absence of leakage of magnetism, the utilizing the most of the iron in the magnet for the double purpose of magnet core and bearing, and the employing of an armature of comparatively large diameter giving high speed with fewer revolutions, the weight of this slow speed motor will rather be lower than higher than that of the high speed motor of same strength now in use.

This motor can be run at as high speed as necessary for railroad trains, if properly wound.

By the absence of gearing, all the disagreeable noise is eliminated.

A New New York Company.

The Engineering Equipment Company, organized early in February, have located temporarily at 73 Cortlandt street, New York. After April 1 they will be in the New Central Building—Liberty, West and Washington streets.

The following gentlemen and others are actively interested in this new and promising enterprise: F. A. Magee, M. E., engineer; F. L. Perrine, general manager; A. L. Tinker, secretary and treasurer. The company are contractors for steam and electric equipment materials. They represent the Underwood Manufacturing Company, of Tolland, Conn., makers of cotton-leather belts and other specialties in the belting line, and are sole agents for the patent indurated fibre pipe used in electrical subway work and for other purposes. The Engineering Equipment Company are also manufacturers' representatives of Corliss and high speed engines, horizontal and vertical boilers, wooden and iron poles, line materials, wire and cables, underground conduits, cars and trucks, iron roofs, cranes, etc.

It is the purpose of this company to furnish equipment materials of the best class at figures which will be attractive to intending purchasers, especially to those who desire to place large orders in safe, reliable hands and under conditions that will insure the exercise of sound judgment by experienced engineers.

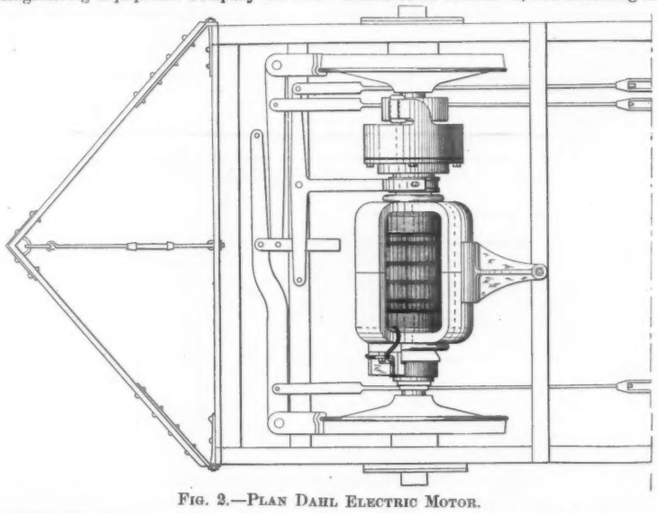

FIG. 2.—PLAN DAHL ELECTRIC MOTOR.

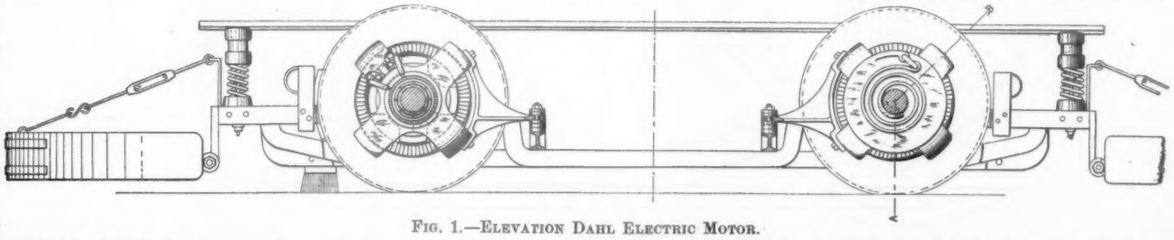

FIG. 1.—ELEVATION DAHL ELECTRIC MOTOR.

The Price of Aluminum.

It must be remembered that at $1 a pound aluminum is really not so high as it looks, for the relation of a pound of aluminum to a pound of other metals is something like that of the famous pound of feathers to the pound of lead. Aluminum is almost three times as bulky as iron, weight for weight; it is nearly four times as bulky as silver, and more than seven times as bulky as gold. Thus if silver were $1 an ounce, and aluminum $1 a pound, silver would be really 50 times more costly, bulk for bulk; aluminum at $1 pound would only be twice as costly as copper at 15 cents a pound.—*Bradstreet's.*

The Condenser Methods of Accelerating Signals.

OFFICE OF THE ENGINEER-IN-CHIEF,
GENERAL POST OFFICE,
LONDON, February 23, 1891.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your issue of February 7 last, you publish an abstract of a paper read at Berlin, by Herr Grawinkel, of the German post office, in which comparisons are instituted between the condenser method of acceleration of signals and certain other devices.

The statements made in the paper would lead one to believe that Herr Grawinkel does not perfectly appreciate or understand the condenser method as used in England, which was very carefully explained to him by the writer in the Winter of 1888–89.

The German administration at the time mentioned used cells of 6ω or 7ω resistance, and it was pointed out that the resistance of the entire sending battery of 100 or 120 volts should not exceed 200ω, although not practically desirable to be less than 100ω.

This question of battery resistance has evidently been a serious stumbling block in the way of increased speed in Germany and it is satisfactory to know that they now recognize this fact, but it is singular to note the statement that when relays were fixed every 100 miles the speed obtainable was less than when the circuit was worked direct to distances over 375 miles.

On a well insulated underground wire, similar to those in use in Germany, with efficient English relays at each 100 miles, a speed of 350 or even 400 English words per minute could be attained, and increasing the length of the circuit would decrease the speed in the ratio of the square of the length.

It is, therefore, very difficult to understand how 30 per cent. increase could be got by cutting out the relays and increasing the length of the circuit, except on the supposition that the signaling and relay arrangements were of the most inefficient description.

The officers of the English administration have repeatedly proved that the condenser method admits of an increased speed equal to 100 per cent. under favorable conditions, and it is probable that Edison's "line killer" arrangement of 1872–3 would, if carefully arranged, give a higher speed than that attainable by the double relay arrangement advocated by Herr Grawinkel.

With reference to Hughes' working, the double relay device puts the line to earth through a resistance when the received signal attains sufficient force to move the recording relay, but as the Hughes instrument earths the line *direct* as soon as the current wave attains sufficient strength, it would appear that Professor Hughes' arrangement is more efficient.

Hoping that you will find space for this commentary in your valuable journal.

I am, yours very truly,

A. EDEN.

ELECTRIC CLUBS.

New York Electric Club.

The Regular Meeting to Nominate Officers for the ensuing year will be held Tuesday evening, March 17. There is no opposition to the re-election of Gen. O. E. Madden, the present incumbent of the presidency, and if he will again accept the position it will, undoubtedly, be tendered unanimously. There are a number of candidates, it is understood, for the other elective positions, and it is likely that there will be a large attendance the evening of the meeting. The interest in the Club is constantly increasing, the natural result of the advance of electrical science, and as there will be a number of able and progressive men to choose from, we hope to see the Club, with President Madden at its head, officered with the best men in the Club. There has been elected during the past year a number of earnest workers in the electrical field, and the nominating meeting will do well to remember this fact and see that many of the new members, with fresh ideas, are honored with positions and responsibilities.

The Following Notice has been sent to all the members of the Electric Club:

At a regular meeting of the Electric Club, held Thursday evening, February 26, 1891, it was voted to admit new members during the succeeding three months, upon the payment of one-half the initiation fee. This offers memberships as follows:

Active—$20 Initiation fee, and $40 yearly dues.
Associate—$10 " $30 "

The object of this change is to rapidly increase the membership of the Club, the limit of which has been raised to 1,000. It is hoped that members will take advantage of this opportunity to bring their friends into the Club.

Several New Members were elected at the meeting of the Board of Managers, Thursday evening of last week. A large number of applicants are waiting for election, the reduction for three months of the initiation fee proving a very popular idea.

"The Electric Club's rapid transit dinner, Thursday night, was a great success. It is one of the few clubs in this city to which it is an honor to belong."—*Jos. Howard, Jr., in New York Press.*

Franklin Electrical Society, of New York.

This Society has elected the following officers to serve for the next six months: President, Newton Harrison; vice-president, Mortimer Newman; recording secretary, Abraham Schreiber; corresponding secretary, Samuel Cohen; treasurer, Max Mayer. The meeting nights have been changed to the second and fourth Saturdays in each month.

New York Telegraph Club.

The Annual Election of the New York Telegraph Club was held last week at its rooms, 32 Cortlandt street. The following officers were elected for the ensuing year: President, E. E. Brannin (re-elected); first vice-president, Richard Kane (re-elected); second vice-president, Thomas J. Dunn; third vice-president, James I. Buxton; recording secretary, J. Clayton Watts; financial secretary, John R. Powers; treasurer, John Brant; librarian, L. E. C. Moore.

Electrical Engineers.

The Fifty-fifth Meeting of the American Institute of Electrical Engineers will be held at the House, 12 West Thirty-first street, on Tuesday evening, March 17, when a paper will be read by Mr. J. J. Carty, electrician of the Metropolitan Telephone and Telegraph Company, on "Inductive Disturbances in Telephone Circuits."

Harvard Electric Club.

The Members of the Club had quite a treat at their last meeting, February 20. Lieutenant Cahoon, of the Thomson-Houston Company, gave a very interesting lecture on the new slow speed motor which the company has just placed on the market. A large number of interesting facts were given about the machine. A car was loaded with three tons of gravel and sent up an incline of 13 per cent. on a curve of 50 feet radius or thereabouts. It took 146 amperes to start the car, but the new motor stood the test and brought the car up the hill successfully. From a series of 500 observations, under all sorts of conditions, it was found that the new motor requires 10 per cent. less current to do a given work than the old type. The motor is well protected from the mud, cobblestones, etc., with which street car motors have to contend. In short, the machine is built for abuse as well as use. The lecturer also gave some interesting facts about the big machines to be built for the West End Road. This 400 horse-power generator will have six poles, and the 250 horse-power will have four poles. The commutator of the 250 horse-power weighs 1,000 pounds, and the whole machine weighs 19 tons. Next Lieutenant Cahoon kept the note books of the Club busy while he gave some capital rules for motor design. Lastly, the speaker showed some curves taken from the motor and answered a host of questions. After a vote of thanks to Lieutenant Cahoon, the Club adjourned.

Electricity in Railroading.

Mr. P. H. Brangs, electrician of the Delaware, Lackawanna & Western R. R. Company, recently delivered an address before the railroad Y. M. C. A., at Hoboken, N. J. Among other things, he said:

The first railroad signal that was operated in this country was tested on the old Camden & Amboy Railroad, now a part of the Pennsylvania Railroad system. Mr. Robert Stewart, telegraph superintendent of this road in 1863, was the first man to construct and experiment with railroad signals in this country. In 1870 to 1873 the block signal

FIG. 1.—INSULITE SOCKET.

system came into general use. The Pennsylvania Railroad Company equipped their entire line from New York to Philadelphia, and during the Centennial year a thorough test of its practicability was made. Not a single accident can now be recalled due to the improper or inefficient operation of the same.

The different systems now in use in this country are the Sykes or English block, the Union S. & S. Company electric pneumatic, the Union S. & S. Company clock-work, the Black automatic mechanical block, the Hall automatic electric signal, and numerous others. The pneumatic electric block system is in operation for eight miles on the New Jersey Central Railroad, the New York Central, West Shore and others. The blocks vary in length from 1,000 to 1,800 feet, and are operated on four parallel tracks.

Another block system which has been quite extensively introduced on the roads of this country is known as the "Hall system." It was first used on the Eastern Railroad (now Boston & Maine), in 1871. In this system the signal is now operated on a closed circuit, running from the battery through the block track instrument, through the magnet of the signal instrument, through the points of relay, through the relay magnets, back to the battery, thus completing a circuit, which holds the signal to safety simply by the force of current. By the momentary breaking of the circuit by a passage of a train over the closed spring track instrument, the magnets of the relay are demagnetized, the points are separated and the signal falls to "danger" by gravity, from lack of force to sustain it in the "safety" position. It will also be seen that from any cause, such as the breaking or crossing of the line wire, the failure of the battery or any of the mechanical parts, the signal will immediately go to "danger" by the interruption of the circuit.

After a signal has been set at "danger," it cannot be restored until the train shall have operated the clear (open track instrument) at the end of the section.

The clearing circuit runs from the battery through the open spring instrument, then through the magnets back to the battery. On completing the circuit through the clear track instrument, the relay magnets are magnetized, the points of the relay are again brought in contact, the former circuit is, therefore, completed and the signal again goes to "clear." If a switch on the main line is misplaced, a circuit is broken in the switch machine attached to the switch, which also causes the signal to fall to "danger."

ELECTRIC RAILROADING.

I think the time is not far distant when railroads will be run by electricity. I do not mean the small street railroads, but large roads running from town to town, and I see no reason why we should not expect to attain higher speed than we do at present with our steam locomotives. There we have reciprocating parts which must be put in motion, stopped and reversed continually, while in electric locomotion we have the simple rotary motion, which is all that is needed, and which makes it possible, accordingly, to run at a much higher speed. Although the steam locomotive has been much improved, still it can hardly compare with the economy of stationary engines, placed where they can have an abundance of water for condensing purposes. We can, therefore, by employing stationary engines and electric roads, do away with a great deal of unnecessary weight, and the moving parts being symmetrical, we can attain a speed of, say, 100 miles an hour. This would, indeed, be a wonderful stride forward, which might save us a great deal of time. As to limiting speeds, it is not easy to say. The very high rates of speed which have been attained, both in this country and abroad, are higher than the limiting figures as they would have been given by many competent authorities only a few years ago. Eighty-six miles an hour have been made on the Northeastern Railway in England; 87 miles an hour have been recorded in this country on the Reading Railroad. These runs have been reported within the present year.

The Insulite Socket.

A new incandescent lamp socket has been put on the market by the Insulite Manufacturing Company, 35 Broadway, New York. It is shown in the illustrations on this page. Fig. 1 represents the socket complete, while in Fig. 2 the working parts are shown with the shell removed.

This device is easily and quickly wired, and possesses a very positive snap on breaking the circuit. Referring to Fig. 2, A is a union swivel coupling, which permits the socket to be screwed home on the fixture without straining the working parts. In wiring the socket for a rigid fixture, the cap is slipped over the line wire pipe, the set screw B is taken out, and the screws D (an

FIG. 2.—INSULITE SOCKET WITH SHELL REMOVED.

insulated screw) and E are loosened. One line wire is inserted in the center tube C, which is held in contact by the screw D, and the other wire is passed between the screw E by the shoulder or lip of the contact spring. The socket is held to prevent twisting the wires while screwing the nozzle home on the line wire pipe. Lastly, the set screw is replaced, which will lock at a half turn of the nozzle.

The insulite socket is made to fit Edison, Thomson-Houston and Westinghouse lamp bases. Mr. Thos. G. Roebuck, with offices at 35 Broadway, this city, is the sole selling agent. It is understood that the Western Electric Company has just placed a large order for insulite sockets.

The Latest Figures.

Whipple's Reports for March, 1891, gives the following information:

CENTRAL STATION COMPANIES.

Stations in United States	1,567
" Canada	120
" Cuba	1
" Mexico	10
Total Stations	1,698

GAS COMPANIES.

Companies in United States	972
" Canada	49
" Mexico	1
Total	1,022
Companies operating Electric Lights, U. S.	281
" " " " Canada	20
" " " " Mexico	1
Total	302

STREET RAILWAY COMPANIES.

Companies in United States	923
" Canada	25
Total	948
Electric Roads in Operation and under Contract in United States	280
Electric Roads in Operation and under Contract in Canada	6
Total	286
Cable Roads in the United States	48

ELECTRIC LIGHT NEWS

—— The Dayton, O., council voted against purchasing an electric light plant for the city.

—— Methuen, Mass., has an article in the Town Warrant asking for $125,000 for electric lights and waterworks.

—— The capital stock of the East Reading, Pa., Electric Light Company has been increased from $150,000 to $300,000.

—— At the close of the past year Paris had 300 arc lamps for public lighting in her streets, and 115 incandescent lamps.

—— The annual meeting of the Thomson-Houston Electric Company, of Boston, will be held April 13, at Middletown, Conn.

—— The London Post Office saved $3,000 last year in the sick leave account by substituting electricity for gas in lighting the building.

—— The sheriff of Grundy county is furnishing Morris, Ill., with electric lights just now. The plant was seized by him a few days ago on an execution.

—— The Thomson-Houston Electric Company, of Boston, has used during the past year nearly 2,500,000 pounds of copper, and about 450,000 pounds of brass rods, castings and bars.

—— The Electric Light and Power Company, of Warren, O., of which E. H. Wells, of Pittsburgh, is treasurer, has sued the city for $2,054.81, for six months' street lighting. The city refuses to pay, alleging poor service.

—— The town commissioners of Frankfort have decided to contribute 1,500 marks to the expenses of the proposed International Electrical Congress. The Chamber of Commerce has also voted 1,500 marks for the same purpose. The Electrical Association is also taking important measures for the furtherance of the scheme.

—— The citizens of Kirkwood, Mo., have subscribed $15,000 toward the Sunset Hill electric light, water and power plant, and many of those who have subscribed pledge themselves to double their subscription if necessary. Over $140,000 in all has been subscribed, and the company feels assured that the remaining $60,000 will be secured in time to begin work by April 1.

—— A plumbing establishment at Iron Mountain are minus their electric lights since the company found out that their current was being tampered with. It was found that the insulated wires furnishing light to the establishment had been scraped bare in at least one place, and various experiments in "electrocution" had been tried. Cats and dogs were the victims. The electricity thus surreptitiously secured was also utilized in scientific experiments in the electric motor line. The company's electrician cut short the researches by summarily removing the wires and lights from the establishment.

An Electric Lighting Puzzle.

Mr. Frank B. Lea writes to the London *Electrical Review* as follows:

"I recently came across an interesting little puzzle in electric light work which may serve to exercise the brains of students, while presenting no great difficulty to the practical man. In the basement of a large house—lined with white glazed bricks and not *too* dry—is a pendant light with china ceiling rose, separate cut-out, and switch in the casing up the wall close at hand. If the lamp be removed from the lampholder some time previously to the observation, and then be replaced, it at once glows with apparently full pressure (100 volts), the switch all the time being 'off.' This glow, however, only lasts for a few seconds, gradually dying down to nothing. When the switch is turned on with the lamp in position, the glow is perfectly normal and continuous. Problem: Find the seat of E.M.F."

KINDRED INTERESTS

The Electrical Supply Company, 171 Randolph street, Chicago, have issued a handsome supplemental catalogue of electric light and power supplies.

The Eastern Electric Cable Company, Boston, are sending out a new set of wire tables and price list of Clark wires and cables, accompanied by a small sample of wire and a report of a very excellent test on Clark wires made by the Buffalo Board of Fire Underwriters.

The Nassau Electrical Company, formerly at 19 Park Place, have been obliged to secure larger and better quarters at 112 White street, this city. The sales of their Nassau capsule battery and other specialties is increasing almost in geometrical progression from week to week.

The Pierce Steam Heating Company, 92 Centre street, New York, have issued some very artistic printed matter describing their products in the steam radiator line. Mr. F. H. Lovejoy, for the past five years associated with the Wainwright Manufacturing Company, of Massachusetts, is now with the Pierce Steam Heating Company.

The Electrical Supply Company, of Chicago, is making many satisfactory sales of Shield Brand moisture-proof wire in various quarters of the West. The advantage of a moisture-proof wire is more and more appreciated, and this wire is now in much demand. The Electrical Supply Company is sending out at the present time a number of artistically printed circulars describing articles of value for electrical men controlled by them.

The Elektron Manufacturing Company, 79 and 81 Washington street, Brooklyn, are issuing a little brochure entitled "Electric Motors Without Commutators." They have so improved their Perret motors by the addition of automatic brushes, that they are as easily taken care of as if they had no commutators. This is the code of "directions for operating" now issued with Perret motors: "Draw the oil from bearings once a week, and refill with fresh oil." That is all the care they need. A number of very strong testimonials are also included in the little brochure.

F. Reddaway & Company, 52 New street, New York, are large manufacturers of belting, their annual production of belting amounting to over 3,000,000 feet. One of their specialties is "camel hair" belting for driving dynamos. It is very pliable, has good wearing qualities and is said to transmit more power than a double leather belt of equal width. They report a test of this belting six inches wide which broke at 14,181. A double leather belt, six inches wide, broke at 7,522. This belting is used by many of the large electric companies in electric light and power installations.

The Central Electric Company, Chicago, has received the following letter:

UNIVERSITY OF MICHIGAN.—PHYSICS AND ELECTRICAL ENGINEERING.
ANN ARBOR, Feb. 12, 1891.

MR. F. W. CUSHING,
Sec'y Central Electric Company,
Chicago, Ill.

Dear Sir:—Some time in the latter part of 1887, the Central Electric Company sent me a coil of 1,000 feet, No. 18 B. W. G. braided Okonite wire, to be used in measuring insulation resistance. For more than six months of the time since it has been under water in a tank. Its insulation resistance has increased rather than the reverse.

At present it measures 16,100 megohms per mile at a temperature of 17 degrees C.

Mr. Patterson, instuctor in physics in my laboratory, has devised a new and improved method of measurement, by which the percentage of error is much reduced.

I can, therefore, give the above result with much more confidence than if the old methods had been used.

The capacity of the 1,000 feet is 0.082 of a microfarad.

Yours very truly,
H. S. CARHART.

PAISTE CHINA SWITCHES.

5 and 10 Ampere Capacity.

FOR FINE RESIDENCE INSTALLATIONS.

IVORY TINTED, TERRA-COTTA TINTED,
BLUE TINTED, GREY TINTED,
YELLOW TINTED, PINK TINTED.
BRIGHT GOLD FINISHED,
DULL GOLD FINISHED,
JET BLACK FINISHED.

Cheap, Handsome, Durable. 5,000 in stock.

ASK YOUR SUPPLY MAN FOR THEM

H. T. PAISTE,
1201 MARKET STREET, PHILADELPHIA, PA.

The Walworth Manufacturing Company has commenced the making of poles for electric roads at their works on second avenue, Pittsburgh.

WANTED!

How to Manage a Small Electric Light Central Station at a Profit to the Stockholders.

FOR ESSAYS ON THE ABOVE SUBJECT I WILL GIVE:

$50.00 for the Best.
$25.00 for the Second Best.
$10.00 for the Third Best.

All answers to be mailed on or before April 15th, 1891, and to be my property. A decision will be given on May 15th, 1891, and literary merit will not be considered, as practical essays are desired. Below are some questions to be answered, which indicates the general nature of what is desired.

What do you consider the best engine, and do you believe in high or low speed engines?
What is the best kind of oil to use?
Give your ideas of the best way to deal with municipal officers for public lighting.
Do you advise arc or incandescent lights for streets, and what are your reasons for preference?
Do you advise using meters for incandescent lights?
Give your method of apportioning cost where you have both arc and incandescent systems
What kind of carbons do you think are best?
How small a power circuit can be put in and made to run profitably; what would you charge for current for electric power; and what generators and motors would you use?
Where it takes three men to run a small station, how would you have the men divide up their time?
How many 16 candle-power incandescent lamps can you run from one ton of coal, and what lamp would you use?
Would you charge for the use of meters?
Would you allow discount for prompt payment or charge net rates? Would you use large or small converters? What is the difference between the output of your incandescent alternating dynamo, as shown by your primary station readings, and the amount for which you make out bills to customers.

Send all answers to
Ferdinand A. Wyman, 131 Devonshire Street,
BOSTON, MASS.

BIDS ON ELECTRIC LIGHT MATERIAL WANTED.

Mr. F. P. Arbuckle, Highlands, Colorado, has taken the contract to build a new Electric Light System in that thriving town, and requests proposals on material. He also desires that manufacturers send him their catalogues at once.

THE LAW BATTERY

IS THE CHEAPEST BATTERY ON THE MARKET.

We think twice before spending a Dollar and would advise you to do the same.

We make a specialty of Pure Zinc and Pure Sal-Ammoniac.

LAW TELEPHONE CO.,
85 & 87 JOHN ST., NEW YORK.

WANTED—Salesmen to represent a Salable line of Electrical Goods to the Trade in New York and on the road. Good men apply. Address,

"H. T. R."

ELECTRICAL REVIEW, N. Y.

THE REMINGTON STANDARD TYPEWRITER

presents the practical results achieved by the best inventive and mechanical skill, aided by capital and the experience gained during the FIFTEEN YEARS in which it has been the

STANDARD WRITING-MACHINE OF THE WORLD!

Send for Illustrated Catalogue.

Wyckoff, Seamans & Benedict,
327 BROADWAY, N. Y.

Burnley Dry Battery

PATENTED JAN., 1890.

STRONGER than any Open Circuit Battery on the Market. **BETTER** than any other Dry Battery yet produced. Most compact in size and cheapest. 90 cents per cell. Discount to the Trade and in quantities.

J. H. BUNNELL & CO.,
Sole Manufacturers and General Agents,
76 CORTLANDT ST., N. Y.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON FEBRUARY 24, 1891.

446,931 Trolley for electric railways. 447,208 Cross-over for trolley lines; Sidney H. Short, Cleveland, O., assignor to the Short Electric Railway Co., same place.
446,966 Cut-out; Stephen D. Field, Stockbridge, Mass., assignor of one-half to Phœbus H. Alexander, New York, N. Y.
446,967 Electric time lock; Malone J. Flowers, Springfield, Mo., assignor of two-thirds to James E. Jones and C. W. Price, both of Oklahoma City, Oklahoma.
446,974 Method of and apparatus for electric welding; Hermann Lemp and Louis M. Schmidt, Lynn, Mass., assignors to the Thomson Electric Welding Co., of Maine.
446,985 Trolley wire hanger; Chas. H. Macloskie and Wm. E. Baker, Boston, Mass.
446,995 Socket for incandescent electric lamps; John M. Orford, Bridgeport, Conn.
447,016 Galvanic battery; Martin W. Robinson, Medford, Mass., assignor to the Vulcan Electric Co., Kittery, Me.
447,023 Electro-heating apparatus; Chas. E. Carpenter, Minneapolis, Minn.
447,045 Magneto-electric signal device; Noel B. Ginochio, New York, N. Y., assignor of one-half to Elias M. Greene, same place.
447,058 447,059 Police signaling apparatus. 447,060 447,061 Municipal signal apparatus. 447,062 Signal box; Bernice J. Noyes, Boston, Mass.
447,074 Non-interference fire alarm signal box; William H. Kirnan, Brooklyn, assignor to the Gamewell Fire Alarm Telegraph Co., New York, N. Y.
447,104 Electric welding apparatus; Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place.
447,105 Independent electric clock; Walter J. Dudley, Everett, Mass.
447,127 Vacuum core for electrical heating devices; Henry R. Butterfield, Waterville, Me.
447,143 Electric heater; John I. Ashbaugh, Chattanooga, Tenn., assignor of one-half to David G. Curtis, same place.
447,166 Telegraph transmitter; Samuel W. Smith, New York, N. Y.
447,177 Regulator for electric circuits; Thos. M. Edwards, New London, Conn., assignor to Thos. W. Williams, same place.
447,181 Apparatus for cleaning railway conduits; William Heckert, Yonkers, N. Y.
447,194 Telephone; Ernest J. P. Mercadier, Paris, France.
447,195 Annunciator and indicator system; John E. A. Miller, San Francisco, Cal.
447,198 Telegraph apparatus; Josiah A. Parker, St. Louis, Mo.
447,215 Electric railway system; Chas. J. Van Depoele, Lynn, Mass.
447,220 Transmitter circuit; Anthony C. White, Boston, Mass., assignor to the American Bell Telephone Co., same place.
447,230 Current-controling device for electric railway cars; Jacob C. Chamberlain, New York, N. Y.
447,255 Electric motor mechanism; Samuel E. Mower, New Haven, Conn., assignor to Henry G. Thompson & Sons, same place.
447,256 Apparatus for flashing and exhausting incandescent electric lamps; William E. Nickerson, Cambridge, and Adolph Berrenberg, Somerville, Mass., assignors to the Beacon Vacuum Pump and Electrical Co., Portland, Me.
447,279 Secondary battery; Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Co., same place.
447,283 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Co., of Connecticut.

ISSUED MARCH 3, 1891.

447,291 Electric dental motor; Harry H. Blades, Detroit, Mich., assignor to the Detroit Motor Co., same place.
447,315 Incandescent lamp socket; Harry J. Gutman, Des Moines, Ia.
447,321 Electric matrix-making machine; Thos. C. Hargrave, Minneapolis, Minn., assignor of one-half to John W. Cobb, same place.
447,332 Electric railway; Walter H. Knight, New York, N. Y.
447,338 Conduit for underground trolley wires; Horace J. Medbery, Ballston, N. Y.
447,350 Electrical subway; John C. Reilly, Brooklyn, N. Y.
447,352 Commutator brush; Edwin W. Rice, Jr., Lynn, Mass., assignor to the Thomson-Houston Electric Co., of Connecticut.
447,353 Electric heater; Chas. C. Rich, Mount Vernon, N. Y.
447,383 Electric arc lamp; Elihu Thomson, New Britain, Conn., assignor to the Thomson-Houston Electric Co., of Connecticut.
447,384 Dynamo electric motor or generator; Elihu Thomson, Swampscott, Mass.
447,409 Electric time lock; Joseph H. Kaiser and Andrew B. Ledwith, Brownsville, Pa.
447,436 Telephone switch system; Claude C. Gould, Batavia, assignor to the Eastern Electrical Manufacturing Co., Wheatfield, N. Y.
447,469 Commutator brush; Wm. Main, Brooklyn, N. Y.
447,482 Electric lighting system; Barton B. Ward, New York, N. Y., assignor to the Electric Construction and Supply Co., same place.
447,485 Telephone exchange apparatus; Franklin G. Beach, Chicago, Ill., assignor to the American Bell Telephone Co., Boston, Mass.
447,486 Universal joint for incandescent lamp brackets; Edwin C. Bennett and Elisha C. Freeze, Chicago, Ill.
447,494 Rheostat; Jeremiah O'Meara, New York, N. Y.
447,495 Turn-out and crossing for line conductors; Sidney H. Short, Cleveland, O., assignor to the Short Electric Railway Co., same place.
447,529 Electro-magnetic cut-out; Giles Taintor, Worcester, Mass.
447,558 Electrical annunciator; William E. Cram, Cambridge, assignor of one-half to Edwin S. Beckford, Quincy, Mass.
447,569 Electrical transformer; Rankin Kennedy, Glasgow, Scotland, assignor of one-half to Robt. Dick, same place.
447,632 Trolley for electric railways; William J. Cavert, Albany, and William P. Wiswall, West Troy, N. Y.
447,676 Electric cut-out; George C. Gammon, Pawtucket, R. I.